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newscientist

LEGACIES OF GOLD
THREATS TO ALASKA'S RIVERS

Patents for life

Remote discoveries

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

BELFAST

The Queen's University of Belfast will host the 1987 Annual Meeting of the British Association for the Advancement of Science. The **Theme** of the Meeting will be **Science and our Surroundings** and the programme will consist of lectures, symposia, specialist conferences, scientific films, excursions, visits to places of interest, social events and trade exhibitions. All sessions will be held in buildings on or adjacent to the main University site and all accommodation is within easy reach of the conference centres.

There will be special events, lectures and competitions for **British Association Young Scientists** and there will also be events for school children.

Further information and details of special conference travel facilities are available from: –

Pauline McIntyre, British Association Local Organising Committee, Queen's University, Belfast BT7 1NN.

1987

PLANT BIOLOGY, ZOOLOGY
& BIOMEDICAL SESSIONS
include

Environmental health; biology of micro-organisms; the changing face of dentistry; diseases of the potato; from myths to molecules; cell function & structure; sex life of plants; new aspects of vertebrate studies; loughs of Northern Ireland; treatment of trauma.

QUEEN'S UNIVERSITY 24~28 AUGUST

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BA IN BELFAST

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NASA/JPL/IPAC

Vol 115 No 1574

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Appointments and situations vacant

Bristol Polytechnic

POSTGRADUATE RESEARCH ASSISTANTSHIP IN MOLECULAR GENETICS

Salary scale: Researcher A £6582–£7371 pa

Applications are invited from candidates who hold an honours degree in an appropriate biological subject or subjects for a post under the direction of Dr Alan Vivian, tenable from 1 October 1987, to study the molecular biology and genetics of host specificity and pathogenicity in Pseudomonas syringae pathovar pisi.

Previous experience of DNA manipulation would be helpful, but the project will provide a training in molecular biological and genetical techniques, including the construction and use of gene libraries. The post is funded by the Agricultural and Food Research Council for a fixed term of three years. The person appointed would be expected to register for a higher degree with CNAA.

For further details and an application form, to be returned by 4 September 1987, please contact the Personnel Office, Bristol Polytechnic, Coldharbour Lane, Frenchay, Bristol BS16 1QY or ring Bristol 656261, Ext 2216 or 2299.

Please quote reference number R/33NS in all communications

Avon is an Equal Opportunities Employer and considers applicants on their suitability for the post regardless of sex, race, disability or sexual orientation.

County of Avon Education Service

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*Charwell House, Wilsom Road, Alton, Hampshire GU34 2TJ
Telephone: Alton 88174 Telex: 858491 INTLAB G

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To assist in the testing of raw materials, finished products and stability studies. Applicants should be qualified to HNC level in chemistry and have two years experience using chromatographic techniques preferably in pharmaceutical analysis.
Starting salaries will be competitive according to qualifications and experience. Other benefits include flexible working hours, a subsidised canteen, 21 days annual holiday and a bonus scheme.
Please apply in writing to:

**Mr A. C. Harper,
Quality Assurance Director, Pharmacal International Limited,
Charwell House, Wilsom Road,
Alton, Hampshire GU34 2TJ**

RESEARCH AND DEVELOPMENT—SENSORS

Biomedical Sensors Limited is a British high-technology company specialising in electrochemical and fibre optic sensors. The company, which is a leader in this field, is going through a period of rapid growth and wishes to expand its development team by filling the following positions:—

SENIOR CHEMIST

A degree in chemistry is essential preferably with a PhD with a background in electrochemistry and/or synthetic organic chemistry.

He/she will specialise in the development of chemical sensors but will also provide chemistry support for the R&D team, and technical support for our present range of sensors. Experience in membrane technology would be advantageous.

PHYSICIST/CHEMIST

The company seeks a graduate (probably CHEMICAL PHYSICS) with experience of optical/spectrophotometric systems or instrumentation, to join the R&D team.

The successful candidate will be part of a team which is involved in the development and evaluation of our new generation of fibre optic chemical sensors.

If you feel that your experience and qualification's meet these requirements, please write enclosing your full cv to:—

bio medical sensors

**Alicia Smith,
Biomedical Sensors Limited,
PO Box 88,
George Street,
High Wycombe, Bucks.
Telephone: 0494 446651**

BLOOMSBURY HEALTH AUTHORITY

DEPARTMENT OF HISTOPATHOLOGY

BASIC GRADE/JUNIOR 'B' MLSO

Required to work in this busy Department which provides a routine diagnostic service for several hospitals within the Bloomsbury district as well as supporting the research and teaching needs of the Medical School.

Applicants for the Basic Grade position should be State Registered MLSO's with Histopathology experience; for the Junior 'B' post a minimum of two 'A' levels (at least one in a Science subject) is required, or an ONC/B TEC in Medical Laboratory Sciences or relevant Science degree.

Salary scales are in accordance with Whitley Council and are as follows:
Basic Grade £6368—£8986 Plus £1201 London Allowance.
Junior 'B' £4009—£5588 Plus £1201 London Allowance.

Application forms and a job description are available from Personnel Department, St Philips Hospital, Sheffield Street, London WC2A 2EX.

Tel 01-242-9831 Ext 28/29.

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Company Bio-Statistician

c. £20,000

Merck Sharp & Dohme is recognised as the world's leading pharmaceutical company. Our philosophy has always been one of consistent innovation which coupled with our first class research pedigree has resulted in many breakthroughs in medical science. At our UK Headquarters in Hoddesdon we are now looking for a senior Bio-Statistician to join our Clinical Research team.

Responsible for all aspects of statistical support to our clinical trials programmes you will be at the forefront of a significant expansion in new pharmaceutical product activity. This will involve close liaison with Clinical Research colleagues in the design of clinical trials, the writing of protocols and the co-ordination and interpretation of trials data. You will also be responsible for developing the Department's statistical resources and fostering close links with R & D facilities in the UK and the US.

Your background is likely to have been within a pharmaceutical or closely-related research environment, and your first degree in Statistics will be backed by at least 5 years' experience in Bio-Statistical analysis.

This is an exceptional opportunity for an accomplished professional to join a team at the leading edge of pharmaceutical development.

Please forward full personal and career details or telephone for an application form:

Richard Crookes, Personnel Manager,
Merck Sharp & Dohme, Hertford Road, Hoddesdon
EN11 9BU. Tel: (0992) 467272.

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CLINICAL RESEARCH ASSOCIATE, EUROPE

Syntex is a research oriented international health care products company, with interests spanning a wide range of therapeutic areas. As a result of continued growth, we are currently seeking a Clinical Research Associate to join the Clinical Research group, based in Maidenhead, Berkshire. This new position reports to one of the Senior Clinical Research Associates and the successful applicant will be responsible for the initiation, co-ordination and monitoring of early clinical studies of novel compounds, or novel indications (Phase I and II) in Europe.

Candidates – ideally life science graduates – should preferably have at least 2 years' experience of protocol development, monitoring and reporting of clinical studies, and, in addition, should be prepared to travel in Europe and the UK. Experience of a number of therapeutic areas will be advantageous.

Personal qualities are equally important and candidates should possess drive, initiative and outstanding communication and negotiation skills, as well as the ability to relate to people of different cultures and levels of seniority.

In addition to a competitive salary, other benefits include a car, discretionary bonus, and after a qualifying period, non-contributory pension and free medical insurance. If appropriate, generous assistance with relocation will be available.

For further information and an application form, please contact Mrs. Jacqueline McNicoll, Assistant Personnel Officer, Syntex Pharmaceuticals International Limited, 23/25 Marlow Road, Maidenhead, Berkshire SL6 7AA. Telephone (0628) 72211.

SYNTEX

This One
QPLQ-JTG-P768

MORE VACANCIES ON PAGES 63–87

Analytical Chemist

Cyanamid is an international pharmaceutical, agricultural and chemical company. The Divisional Laboratories at Gosport carry out pharmaceutical research and development on new clinical compounds for worldwide markets, as well as product development of both ethical and OTC products.

The Analytical Group which supports this development requires a graduate chemist who should have some post qualification experience in analysis of pharmaceuticals. Experience in the manipulation of biological fluids to GLP standards would be an advantage.

You should have a flair for investigative analysis and be familiar with HPLC and GLC techniques.

You would be part of a team, aided by Assistant Chemists testing and developing projects until they are ready for manufacture. Interpersonal and supervisory skills will therefore be important for you now and for the future.

The salary offered will reflect our commitment to employ high calibre people and relocation expenses to this attractive part of South Hampshire will be paid.

For an application form telephone Fareham (0329) 230941 (Ansaphone), or write with C.V. to Personnel Department, Cyanamid of Great Britain Limited, P.O. Box 7, Fareham Road, Gosport, Hampshire, P013 0AS.

CYANAMID

Technical Information Officer

Harlow, Essex

Smith & Nephew Research are seeking a young Technical Information Officer to join a small and versatile team of information specialists involved in all aspects of technical and commercial information work for the Smith and Nephew Group.

Primary responsibilities would be technical literature searching in support of the Smith and Nephew research programme, technical enquiries from production and sales companies, and scanning of technical journals for input to current awareness bulletins. The product range of the Smith and Nephew Group includes medical and healthcare products, pharmaceuticals, textiles, toiletries and plastics, and the range of technical literature handled is correspondingly wide, from medicine to materials science.

Some participation in the development and maintenance of library systems will be expected.

The ideal candidate will have a good honours B.Sc. in a relevant scientific discipline and an M.Sc. in information studies. Experience of information work would be an advantage but is not essential.

Smith & Nephew Research Limited, is the central research and development unit for the Smith and Nephew Group and is situated on a country estate just outside Harlow, Essex.

A competitive salary will be offered and other benefits include 25 days holiday, flexible working hours, pension scheme and free life assurance. Please send career details or telephone for an application form from: Gill Pitkethly, Personnel Manager, Smith & Nephew Research Ltd., Gilston Park, Harlow, Essex CM20 2RQ. Tel: (0279) 26751.

Smith+Nephew

COVENTRY POLYTECHNIC
Department of Applied Physical Sciences
RESEARCH IN SONOCHEMISTRY
(Use of Ultrasound in Chemistry)

Applications are invited from suitably qualified candidates (at least an upper second class honours degree in chemistry or related discipline) to join the Coventry Polytechnic Sonochemistry group which is in the forefront of this new and exciting field of research.

Ultrasonic irradiation is known to enhance chemical reactivity in homogeneous, heterogeneous and catalytic systems. This project will focus on the applications of ultrasound in polymer chemistry and is in cooperation with Doverstrand Limited.

The project is SERC sponsored and of two or three years duration leading to an MPhil or PhD Degree.

Send cv to Dr T. J. Mason, School of Chemistry, Coventry Polytechnic, Priory Street, Coventry CV1 5FB. Closing date: Wednesday, 9 September, 1987.

We welcome applications from men and women regardless of disability, race or marital status.

PORTSMOUTH AND SOUTH EAST HAMPSHIRE HEALTH AUTHORITY
Saint Mary's Hospital, Milton Road, Portsmouth, Hants PO3 6AD
PHYSIOLOGICAL MEASUREMENT TECHNICIAN (Cardiology)

Required to work in this busy friendly department. The department is responsible for ECG's, stress testing, Ambulatory Monitoring, Echocardiology, and Doppler Pacemaker follow-up plus some respiratory function studies. Applicants must have OTec or relevant experience. The grading for this post is under review, therefore at time of advertising it still stands at Whitley Council Basic Grade PMT. Further information from Mrs Christine Grandison, Senior Chief Technician on Portsmouth (0705) 866731. Application form and job description available from the Personnel Department, Saint Mary's Hospital on Portsmouth 866480. Closing date: 31 August, 1987.

ST MARY'S HOSPITAL MEDICAL SCHOOL
(University of London)
MLSO/JUNIOR B

A vacancy exists for an MLSO to join a group investigating the immune response to hepatitis viruses. The work will mainly involve the development and preparation of monoclonal antibodies to the hepatitis virus proteins and the development of immunological techniques. Training is available in these techniques.

Salary on Whitley scales. The post is available for one year in the first instance.

Applications in the form of a full cv with names and addresses of two referees should be sent to Assistant Secretary (Personnel) at above address by 11 September.

Technical Officer

Animal Breeding Unit

£12,490 to £13,500 Cheshire

ICI Pharmaceuticals Division at Alderley Park in Cheshire, is the headquarters of a thriving research based International business. Continued success in the area of product discovery and development has created an opportunity for a highly experienced Technical Officer in the field of Animal Breeding.

This is a new position within a recently formed Technical Support Team. Led by the Technical Manager, this team will provide a technical resource in the areas of animal production, isolator/S.P.F. barrier technology, health and genetic monitoring/control, quality control and training.

This is a particularly exciting time to join ICI; the breeding unit is at present undergoing major changes in its working practices, S.P.F. barrier improvements and computerisation of production systems. In addition, further developments planned for the early 1990's will create excellent opportunities for both personal and career development.

Applicants will have a degree or equivalent in Biological Science or Fellowship of Institute of Animal Technicians, together with a minimum of 5 years' experience of working in S.P.F. breeding/toxicology animal facilities. Specialist knowledge and experience within the areas of barrier and isolator technology, laboratory animal breeding and maintenance, health monitoring, genetic control, quality control and assurance are essential.

Good interpersonal skills and a numerate/analytical mind are also necessary requirements of the job, whilst knowledge in the operation of computer systems and experience in a formal training role would be advantageous.

In addition to a highly competitive salary, commensurate with experience, we offer excellent terms and conditions, including contributory pension scheme, employee profit sharing and a generous relocation package to this attractive part of the country.

Please send a c.v. or write for an application form to:

ICI

The Recruitment Officer (ES), Personnel Department,
Imperial Chemical Industries PLC,
Pharmaceuticals Division, Alderley House,
Alderley Park, Macclesfield, Cheshire SK10 4TG.

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Busy industrial publicity group seeks qualified technical editor for Brussels to work with client in the international chemical industry.

The job will involve co-ordinating, checking and progressing a wide range of sales and technical literature produced initially in English but then translated into most major European languages. This involves working with a range of established freelance and agency contacts around Europe as well as with a worldwide network of client sales offices.

You should be technically qualified in physics or chemistry to HNC or degree level and be capable of expressing yourself clearly in English. Experience of proofreading, project planning and progressing essential with a reasonable degree of computer literacy.

Initial interview will be held in our Coventry office. The successful candidate would receive a short training in the UK before moving to Brussels.

Please apply in writing with cv to:

Paul McCallum

COMMUNICATION SYSTEMS S.A.
ADVERTISING □ PUBLIC RELATIONS □ MARKETING
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MORE VACANCIES ON PAGES 63–87

Experienced Q.C. Chemist

A team leadership role with this rapidly expanding Chemicals Group

Warrington

Innovation, service and a devotion to achieving the highest standards in production have been the key contributors to the rapid development of this young, profitable, privately owned group.

We specialise in the manufacture of speciality chemicals and pharmaceutical intermediates for a wide range of markets and are now looking for a specialist to take responsibility for the QC Function at our Warrington plant. Reporting to the Technical Director and responsible for a team of 3 Chemists, your major role will be to administer our QC systems. It's a 'hands-on' position involving instrumental analysis and the development of new analytical techniques as well as close liaison with our process control team to ensure that quality is built into the system from the outset.

You'll be a graduate Chemist with 3 years' industrial experience, probably currently involved in QC within Pharmaceuticals/Fine Chemicals and looking to develop your career in a supervisory role within an expanding company. Man-management ability will combine with BS5750 familiarity and a sound appreciation of the interrelationship between QC and process control.

We offer an attractive salary, along with the usual benefits and relocation expenses, where applicable.

Please write with full personal and career details to Brian Trenberth, Technical Director, Contract Chemicals Ltd, Penrhyn Road, Knowsley Industrial Estate, Prescot, Merseyside L34 9HY.

Contract Chemicals

CLARENDON LABORATORY AND MATHEMATICAL INSTITUTE

University of Oxford

POST-DOCTORAL APPOINTMENT IN NONLINEAR SYSTEMS

Applications are invited for an SERC-funded post in a small inter-departmental team carrying out research into nonlinear hydrodynamic phenomena. The post will reinforce the experimental part of the project in the Clarendon Laboratory and will carry responsibilities for use of a MASSCOMP computer system. The principal responsibility will be to develop new signal-processing methods in collaboration with RSRE, Malvern. Applicants need not have research experience in hydrodynamics, but an interest in modern ideas about chaotic dynamics could be an advantage. The appointment will be for three years in the first place with salary in the range RAIA £9305-£14 825 (under review) depending upon age and experience. Applications including the names of two referees should be sent to Prof T. B. Benjamin, FRS, Mathematical Institute, 24/29 St Giles, Oxford OX1 3LB by 14 September, 1987.

THE NATIONAL INSTITUTE FOR MEDICAL RESEARCH
THE MEDICAL RESEARCH COUNCIL CENTRE FOR COLLABORATIVE RESEARCH

SAFETY OFFICER

Applications are invited for the post of Head of Safety Section (Senior Scientific Officer Grade).

As Safety Officer you will be responsible for all aspects of safety within a research environment, ie Radiological, Biological, Chemical, General Safety and Security. In addition, you will be required to organise and act as secretary to the Institute Safety Committee.

As Head of Safety Section you will head a team of three technical and six security staff.

The post involves a substantial element of training, report writing and provision of advice. Candidates should therefore have at least three years experience in the safety field, preferably in a research environment, a sound knowledge of relevant legislation, and good communication/administrative skills. The salary will be in the range £12 341-£15 820 pa, inclusive of London Weighting and pension supplement, with 22 days annual leave not including 10½ days public, bank and privileged holidays (pay award pending).

The Institute is in pleasant rural surroundings and is close to Mill Hill East Tube and local bus routes and has good working conditions with excellent sports and social facilities.

Please telephone for an application form and further details on 01-959-3666, extension 221 or write, quoting reference 0315/AS to Mr N. J. Bowry, Personnel Officer, NIMR, The Ridgeway, Mill Hill NW7 1AA. Closing date for applications is 11 September, 1987, with interview in week commencing 21 September.

An Equal Opportunities Employer.

MILTON KEYNES GENERAL HOSPITAL

Department of Pathology

MLSO/JUNIOR MLSO—MICROBIOLOGY

Applications are invited for basic grade (state registered) or Junior MLSO in the Department of Microbiology. The Department is progressive and well equipped, providing a comprehensive service to both the three year old 350 bed Hospital and the surrounding health district. This is an ideal post for career development and encouragement will be given for further study.

Further details can be obtained and informal visits arranged by telephoning Mr Don Clarke, Chief MLSO, on (0908) 660033, Ext 2407.

JUNIOR MLSO—CHEMICAL PATHOLOGY

Applications are invited for the above post. Candidates should possess either two 'A' Levels (one of which must be chemistry), an ONC in Medical Laboratory Sciences or a Science Degree acceptable to the CPSM. This progressive Department which is well equipped offers a wide range of investigations using a variety of techniques. This is an ideal post for career development and encouragement will be given for further study.

For further information and to arrange a visit contact Mr Bob Winton, Chief MLSO, on (0908) 660033, Ext 2043.

Application forms and job descriptions available from: Mr P. Dilworth, Senior Chief MLSO, Pathology Department, Milton Keynes General Hospital, Eaglestone, Milton Keynes MK6 5LD, Tel (0908) 660033, Ext 2804.

Closing date: 28 August, 1987.

Southampton
THE UNIVERSITY

Faculty of Science

Department of Physics

POSTDOCTORAL APPOINTMENT IN HIGH TEMPERATURE SUPERCONDUCTIVITY

Applications are invited for a postdoctoral research assistantship, funded for three years by the SERC, in support of a multi-disciplinary group working on the synthesis and characterisation of novel high temperature superconductors. Applicants should have a suitable background in experimental solid state physics or solid state chemistry.

Applications by letter with CV and names/addresses of two academic referees to Professor B. D. Rainford, Physics Department, Southampton University, Southampton SO9 5NH. Initial salary within the range £9305-11 015 according to age and experience.

Closing date: 18 September, 1987.

The Sterling Research Group is the corporate research and development arm of Sterling Drug Inc., a leading U.S. pharmaceutical company (Fortune 200) with worldwide interests.

The integrated Research Group operations are carried out at facilities in the USA and Europe, supporting the Sterling Drug Inc., commitment to pharmaceutical research as the essential element for growth and profitability.

This has led to continuing expansion of the research effort at our new 200 strong Research and Development Centre which has responsibility for development programmes on new compounds from safety evaluation through to analytical and pharmaceutical development including metabolism, pharmacokinetics and clinical pharmacology to Phase 1 study supplies.

HEAD OF ANALYTICAL METHOD DEVELOPMENT SECTION

This position offers both technical and managerial responsibility and reports to the Head of Chemistry and Analytical Department. The successful candidate will lead a team of 8 graduates, controlling and participating in the innovative development of methods for the analysis of raw materials (including NCE's), formulated products including those undergoing shelf life testing. Emphasis is placed on the development of accurate and reliable methods using the latest techniques and equipment.

The ideal candidate will hold a PhD in an appropriate subject obtained after a good honours degree in chemistry, or possibly pharmacy, and will have had at least 4 years experience in the pharmaceutical industry or equivalent. He or she will need to have good communication skills both written and oral in order to interrelate with other groups including those in the USA.

This is a key position at the modern, purpose built Research Centre at Alnwick, a Northumberland market town ideally located close to a National Park and a beautiful coastline while still being within easy reach of the cities of Newcastle and Edinburgh. An attractive remuneration package including the usual benefits of a major company will be offered for the right candidate.

To apply, please send a CV, to;

The Personnel Controller, Sterling Research Group Europe, Sterling-Winthrop Research Centre, Alnwick, Northumberland, NE66 2JH.

Sterling Research Group Europe

Opportunities In Biosensor Research

Biochemical and Biophysical Scientists

ICI Diagnostics and Newcastle University are collaborating in an exciting research programme at the leading edge of Biosensor Technology and its application to diagnostic medicine.

We are now seeking to recruit innovative research scientists with a background in either physical or biological sciences who can really make the most of the resources and superb facilities offered by a joint venture between these leading organisations. Previous involvement in biosensor research is not necessary, however, experience in biochemistry, membrane science or electrochemistry would be advantageous.

As part of our multi-disciplinary team you will be expected to make a substantial contribution to the understanding and development of biosensors for clinical applications in a role which represents a good opportunity for enthusiastic scientists to enter this growing field.

Applications are invited from candidates with 2-5 years' post graduate experience and preferably a higher degree. The successful candidate will be joining an ICI/SERC funded group with starting salaries up to £11,015, dependent on age and experience.

For further information please contact Dr P Vadgama on 091-232 8511 ext 3132 or write enclosing a CV to:

ICI Diagnostics

Dr P Vadgama, Department of Clinical Chemistry,
Medical School, Framlington Place,
Newcastle-upon-Tyne, NE2 4HH.

MORE VACANCIES ON PAGES 63—87

UNIVERSITY OF SOUTHAMPTON

DEPARTMENT OF PHYSICS

Four Lectureships in Experimental Physics

The Department of Physics has been given a major opportunity for expansion through the appointment of four lecturers in support of existing research activity. The department's experimental research has particular strengths in the areas of High Energy Astronomy (development of imaging gamma ray telescopes including the GRASP satellite), Solid State Physics (magnetism, neutron scattering and superconductivity) and Laser Physics (non linear optics, high resolution spectroscopy and optical fibre lasers).

One appointment will be made in each of the following areas:

SPACE PHYSICS/GAMMA-RAY ASTRONOMY
SOLID STATE PHYSICS/MAGNETISM
OPTO-ELECTRONICS/LASERS

The fourth appointment will be in one of the following areas

LASER SPECTROSCOPY/QUANTUM OPTICS
SOLID STATE PHYSICS/SUPERCONDUCTIVITY

Further particulars may be obtained from **Mr H. F. Watson, Staffing Department, The University, Southampton SO9 5NH** *to whom seven copies of applications, including a full CV and the names and addresses of three referees, should be sent to arrive not later than 15 September 1987, QUOTING REFERENCE NUMBER 296/HEW.*

THE UNIVERSITY OF LEEDS
Department of Microbiology

POSTDOCTORAL RESEARCH FELLOW

(Antifungal Drugs)

Applications are invited for the above post which will involve a three year study of the enzyme chitinase in the pathogenic fungus *candida albicans*, with a view to this enzyme being a target for antifungal drugs. The work will have both medical and industrial dimensions and will involve protein purification and characterization, construction of gene libraries and characterization of the genes involved.

Applicants should have a good honours degree in a biological science and have or shortly expect to obtain a PhD in a related area.

The post is available for a fixed period of up to three years from 1 October, 1987.

Salary within the range £9305–£11 015 on RA Grade 1A (£9305–£14 825) according to qualifications and relevant experience.

Informal enquiries may be made to Dr D. J. Adams (Tel (0532) 441199 Ext 225/227).

Application forms and further particulars may be obtained from and completed applications sent to the Registrar, the University, Leeds LS2 9JT, quoting Reference No. 96/43. Closing date for application 10 September, 1987.

MRC Clinical Research Centre
(Northwick Park Hospital)
Watford Road, Harrow
Middx HA1 3UJ

TECHNICIAN

A vacancy exists in the Division of Immunochemical Genetics for a Technician with a degree, HND or equivalent qualification in chemistry or biochemistry.

The work of the division is concerned with the molecular basis and genetic regulation of carbohydrate entigens as exemplified by certain blood group entigens. The successful applicant will be required to isolate oligosaccharides from natural sources and to undertake chemical synthesis of disaccharides and nucleotide sugars by established procedures. Previous experience in carbohydrate chemistry would be an advantage.

Salary will be within the range £7086–£9704 (pay award pending) depending on age and experience. Application forms and further details may be obtained from the Personnel Section, 01-864-5311 Ext 2673. Quoting Ref: 134/2/3649.

Closing date for applications: 10 September, 1987.

The Medical Research Council is an equal opportunity employer.

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Incorporating Avery Hill and Garnett

SCHOOL OF MATERIALS SCIENCE AND PHYSICS

RESEARCHERS

Due to expansion of the DCEL Displays Group on the DTI (ALVEY)/SERC funded research programme, and overseas sponsored research, vacancies now exist for the following temporary one-year posts:

1 A graduate in physics/electronics with previous experience in one or more of the following: solid state devices, digital systems, computing.
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2 Materials Scientist or Chemist with previous experience in the preparation of luminescent materials.
Salary: :£9123 inclusive.

3 Research Worker—a graduate of HNC/HND holder with experience of preparative inorganic or organic chemistry.
Salary £7275 inclusive.

4 Research Worker—an electronic laboratory technician, HTC level, experienced in circuitry work.
Salary: £7275 inclusive.

In posts 1, 3 and 4 the successful applicants will be encouraged to register for higher degrees.

Further information may be obtained from Mr A. Vecht, School of Materials Science and Physics (01 854 2030, Ext 868). Application forms from the Staffing Officer, Thames Polytechnic, Wellington Street, London SE18 6PF, to be returned by 8 September, 1987.

Thames Polytechnic is an equal opportunities employer.

ASTON UNIVERSITY
Department of Computer Science & Applied Mathematics

TWO RESEARCH OFFICER POSTS IN SOFTWARE ENGINEERING

In recent years, the department has been steadily expanding its expertise and research base in key technologies within the field of Information Engineering. Two vacancies now exist for Research Officers to join a newly established Software Engineering venture that will address the development of an integrated toolkit for the generation of experimental implementations of systems for their abstract specifications. The two posts will provide an ideal opportunity for people seeking to develop their career who wish to work in a stimulating environment using the latest equipment on a challenging R&D project.

Applications are invited from people of proven ability who have at least a 2i honours degree in Computer Science and possess (or will shortly obtain) a relevant postgraduate award; persons with equivalent qualifications and/or experience will also be considered. Applicants must possess good software engineering skills and have the flair, know-how and initiative to tackle complex innovative software design. Although not essential, some familiarity with Jackson methods would be an advantage.

The two posts will take effect from 1 November, 1987, or as soon thereafter as possible. Both appointments are initially for three years. Depending on status, starting salaries will be not lower than the fourth point £11 015 pa of Research Grade 1A (£9305-£14 825 pa). Salaries will increase by 6 per cent on 1 March, 1987.

Further information can be obtained informally from Mr Bryan Ratcliff (Tel 021-359 3611, Ext 4250). Application forms and further particulars may be obtained from the Personnel Officer (Academic Staff), Aston University, Aston Triangle, Birmingham B4 7ET (Tel 021-359 0870—24-hour answerphone), quoting Ref 8734/32. Closing date for the receipt of applications is 4 September, 1987.

UNITED MEDICAL & DENTAL SCHOOLS
(St Thomas's Campus)

LABORATORY SCIENTIFIC OFFICER

Laboratory Scientific Officer required in the department of surgery to commence Sept/Oct, 1987.

Some experience in Physiological measurement, blood flow, Doppler, handling and counting of isotopes, use of computers required. Also there will be other general duties in the Department.

For formal enquiries please call Mr D. L. Rutt on 01-928 9292, Ext 2424.

Salary on scale: £6368-£8986 plus £1201 London Weighting.

Please apply with full cv and the names of two referees to the Staffing Officer, UMDS, St Thomas's Campus, Lambeth Palace Road, London SE1 7EH, quoting Ref STH/SURG/189A.

Technicians

Shell Research Centre
Sittingbourne
Kent

Shell

Shell Research Limited in Sittingbourne, Kent has vacancies for Technicians to work in a team involved in the study of microbial systems as industrial biocatalysts. The work will involve the application of microbiological and biochemical techniques to select and assess suitable microorganisms for particular chemical transformations and to study aspects of microbial physiology and metabolism relating to biocatalytic potential.

The successful candidates will most likely possess H.Tec or equivalent in microbiology and biochemistry and preferably will have had previous experience, both practical and theoretical, in either fermentation, biocatalysis or microbial metabolism.

The Research Centre has modern, well-equipped laboratories situated on an approximately 500 acre farmland site. You will be able to join our pension fund and other benefits include a subsidised staff restaurant and excellent sports and social facilities.

If you are interested and have the necessary qualifications, please write for an application form to:-
Mrs. D. King,
Personnel Division,
Shell Research Limited,
Sittingbourne Research Centre,
Sittingbourne, Kent ME9 8AG.
(Please quote ref No: 870028/29/30)
The closing date is September 4, 1987.

UNIVERSITY OF SOUTHAMPTON

DEPARTMENT OF OCEANOGRAPHY

Research Assistantships

1. **STUDIES OF DEEP OCEAN MIXING; DATA ANALYSIS AND INTERPRETATION**

A three research assistantship at postdoctoral level is available in the Department of Oceanography to study processes of lateral mixing near the ocean margins, especially near the continental slope. The work will involve the analysis of data from oceanographic sensors, including CTDs and current meters, and the interpretation of data within the frame of existing knowledge of eddies, slope waves and the generation of vertical modes. The objective is to develop a better understanding of the processes and especially the consequences of slope mixing and lateral, or isopycnal dispersion by a combination of empirical formulation and theoretical, perhaps numerical, modelling. The work may involve one cruise to assist in the recovery of moorings.

Applicants should have some knowledge of waves and ocean turbulence, with preferably a sound background in theoretical fluid dynamics and some experience in data handling and perhaps numerical modelling. The appointment will commence on 1 December, 1987 and be subject to the normal rates for NERC PDRAs.

2. **ANALYSIS OF DATA/MODELLING OF THE UPPER OCEAN USING SONAR TECHNIQUES**

A research assistant, preferably at postdoctoral level, is required to support studies of turbulence, temperature and bubbles in the upper ocean using various techniques including sonar. The work will involve data analysis, the study of processes of mixing and surface waves, and the development of analytical and numerical models of the near-surface ocean. Funding is available for a two and a half year appointment beginning immediately.

Applicants should have interests in oceanography, fluid dynamics or in underwater acoustics, have some experience in computing and be willing to spend time at sea. Experience in analytical or numerical modelling technique would also be valuable. The salary scale will depend on the qualifications of the successful candidate.

For both posts the closing date for applications is 11 September, 1987.

Applications enclosing a cv and names and addresses of two referees should be sent to Professor S. A. Thorpe. The Department of Oceanography, The University, Southampton SO9 5NH. (Tel 0703 559122, Ext 3755), who can provide further information.

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MORE VACANCIES ON PAGES 63–87

Opportunities in Thermal Hydraulics Research

Harwell is the largest research laboratory of the United Kingdom Atomic Energy Authority and is situated in pleasant countryside midway between Oxford and Newbury. Its Thermal Hydraulics Division, carrying out both fundamental research and applied contract work in both the nuclear and non-nuclear areas, currently has vacancies offering challenging and stimulating work in the areas:

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You will be involved in the construction and synthesis of mathematical models for complex engineering problems and the development of predictive methods.

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Starting salaries, depending on age and experience, will be in the range £9,865 to £16,280 with prospects of further progression to £20,600. The recruitment package also includes generous leave arrangements, an excellent contributory pension scheme and, where appropriate, relocation assistance.

For an application form and further information please write to Mrs J Bevan, Recruitment Branch, Harwell Laboratory, Didcot, Oxfordshire, OX11 0RA or telephone Abingdon (0235) 24141 extension 3169 or 2614 (24 hour answer phone).

Please quote reference number NS/1868.

The closing date for applications is 25 September 1987.

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Research Scientist

Life Science Laboratory Instrumentation

Shandon are leaders in the design and manufacture of clinical laboratory equipment. An aggressive R & D programme is at the heart of our expansion and we now need an additional scientist to complement our existing team. Your prime objective will be to identify and investigate new approaches and techniques in life science laboratory instrumentation to both improve existing products and to develop new ones.

Candidates should have a good honours degree in a biological/biochemical or related discipline and an interest in laboratory automation and instrumentation. In addition, 2-3 years experience in a clinical laboratory environment would be an advantage.

Salary will be commensurate with age and experience and relocation assistance to the N.W. Cheshire area, which has excellent recreational and residential facilities, will be provided in appropriate circumstances.

Either 'phone Runcorn (09285) 66611 for an application form or send a detailed C.V. to:
Mrs E Ellis-Seabridge, Personnel Officer,
Shandon Southern Products Ltd, Chadwick Road,
Astmoor, Runcorn, Cheshire WA7 1PR.

SHANDON

UNIVERSITY OF GLASGOW

Wellcome Laboratories for Experimental Parasitology

RESEARCH ASSISTANT

Applications are invited for the post of Research Assistant to work on a project funded by the Wellcome Trust to carry out an immunochemical analysis of the lungworm of cattle, *Dictyocaulus viviparus*. This is the only nematode parasite against which a vaccine is in extensive use and the objective is to begin to understand the active principle of a working vaccine at the molecular level, with a view to the rational development of novel anti-nematode vaccines. The successful applicant will join established groups working on nematode parasites of man and domestic animals. No previous knowledge of parasitology is required, but a background in biochemical and immunological techniques would be advantageous.

The post is for three years and the salary will be in the range £8410-£9865 pa. Applicants must have an honours BSc degree or equivalent and the post carries with it the opportunity to register for a higher degree.

Applications (two copies) should contain a cv, the names, addresses and telephone numbers of two academic referees and be sent to Prof G. M. Urquhart and Dr M. W. Kennedy, Wellcome Laboratories for Experimental Parasitology, University of Glasgow, Bearsden, Glasgow G61 1QH, to arrive not later than 10 September, 1987. Further information can be obtained from Malcolm Kennedy on 041-339 8855, Ext 5819.

UNIVERSITY OF NOTTINGHAM

PHYSICAL CHEMISTS/PHYSICISTS

for research into the Glassy State in Foods

Applications are invited for two posts, one at postdoctoral. The second at postgraduate level to staff a project to investigate the significance of glassy/rubbery states in foodstuffs; this is now seen as a topic of major importance to the food industry. The study will concentrate on the relation between the dynamic mechanical response of selected proteins and polysaccharides and their molecular dynamics and state. The project is at the sharp edge of very active research groups at Nottingham University and Unilever Research and is pioneering in ideas and concept. It is also of a collaborative nature and will involve research both at Nottingham University and Unilever Research and a variety of physical and spectroscopic techniques. The project is funded by both MAFF and Unilever Research and is a core project from which a range of industrially-supported satellite projects are expected to develop.

Further details can be obtained from J. M. V. Blanshard, Reader in Food Science, Department of Applied Biochemistry & Food Science, Nottingham University, Sutton Bonington, Loughborough, Leics LE12 5RD to whom applications should be made as soon as possible.

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Ruffled feathers

THERE is a story about two vultures perched on a cliff overlooking a barren desert waiting for something to die. One says to the other: "God this is boring. Let's go and commit murder." This apocryphal tale is not unlike the situation that happens to newspapers at this time of the year. Instead of news "happening", journalists begin to generate their own.

Fortunately for the hard-pressed news editors of Fleet Street, or wherever the hacks have migrated to these days, one news item came their way with little encouragement from the press. For no apparent reason eminent scientists began spilling each other's blood over whether archaeopteryx, the fossil that bridges the gap between reptiles and birds, is genuine.

The story itself is an old one. Sir Fred Hoyle, an astrophysicist with a penchant for rubbing the scientific establishment up the wrong way, and his colleagues voiced their doubts over the fossil in 1985. The new "angle" is that the controversy has become a bare-knuckled fight between Hoyle and friends, in one corner, and, palaeontologists at the Natural History Museum in London, which owns the fossil, in the other.

Two weeks ago, Hoyle, Chandra Wickramasinghe from University College, Cardiff, and Lee Spetner, a physicist from Israel, made some damning remarks about the scientists at the Natural History Museum (This Week, 13 August, p 27). They suggested that archaeopteryx is not only a forgery, but a forgery that is being sustained by scientists at the museum.

Hoyle said that the museum refuses to relinquish a tiny pinhead of material from the fossil for "independent" tests that would show unequivocally whether or not the fossil is genuine. He and Spetner also suggested that the museum has mislaid or destroyed a large chunk of material that contains the brain case of the animal.

Understandably, the scientists at the museum are angry. They have presented new evidence that powerfully supports their case that the fossil, and its feathers, are indeed genuine. Angela Milner, who is in charge of fossil amphibians, reptiles and birds at the museum, and her predecessor, Alan Charig, do not take kindly to Hoyle's insinuations that they are crooks. "We bitterly resent the libellous allegations of unprofessional conduct on our part," Milner said this week.

Milner and Charig have a right to be angry. Spetner's flimsy data, and Hoyle's arguments, which he bases on photographs of the fossil, pale into insignificance alongside the museum's exhaustive analysis of the fossil.

Hoyle says that the impressions are the result of someone pressing modern feathers into an organic glue. Researchers at the museum have performed tests on the rock, looking at it under a fluorescent light. This shows that there is little or no organic material around the impressions in the rock of the animal's feathers. Calcite crystals, which take millions of years to form, fill the hairline cracks in the feathered areas right to the brim. No layer of Victorian paste sits on the surface of the rock.

Sir Fred is a fine scientist, and the world would be a duller place without his style of questioning accepted wisdom. Nevertheless, he has overstretched his licence in regard to archaeopteryx. He should look at the latest evidence from the museum and be prepared to apologise if the museum can convince him, as it has the whole field of vertebrate palaeontology, that the half bird, half reptile did indeed exist, perched above the barren landscape of 150 million years ago. □

Prime target

THERE has been much comment on the arrival of Mrs Thatcher as the overseer of science policy in Britain, as was revealed last month in a White Paper that also heralded the birth of the new Advisory Council on Science and Technology. Before anyone gets too carried away by Mrs Thatcher's decision to take over at the helm of the government's science policy, they would do well to cast their minds back to 1979. Mrs Thatcher answered in the House of Commons a question about the perennial issue of who should be the "science supremo" in government.

After spelling out the lines of departmental responsibility, the Prime Minister, who was still relatively new to the job and had not yet succeeded in upsetting the scientific community, went on to say: "In appropriate cases I would play a coordinating role myself." Perhaps unwisely, we welcomed this as a sign that the (newish) government would take science policy seriously (*New Scientist*, 8 November 1979, p 418). We had certainly overestimated the likely outcome, as we found when our own insider in the corridors of power sent the Prime Minister a copy of our support for her new role.

The PM's response was less than enthusiastic. In her reply to Tam Dalyell, Mrs Thatcher suggested that we had "read a little too much" into the answer. It wouldn't have been the first such over-indulgence on our part—and there have doubtless been other cases since. There was, though, the suggestion in Mrs Thatcher's letter that times might change. "... I believe that our system is working well", the Prime Minister wrote. "But I shall keep an eye on it, not least because it is so important that British science should continue to flourish."

Well, science can hardly be said to have flourished since 1979. As the PM also said in her letter: "Occasionally an issue involving several or all Ministers may arise where it would be sensible to ask a department Minister to take the lead, and in such cases I stand ready to undertake the necessary coordination myself." Such an occasion must surely be the present. Therefore, once again we welcome Mrs Thatcher to the driving seat of science policy. There is, though, the nagging suspicion that if she had not been so quick to reject the notion in 1979, science might not now be in so parlous a state. □

THIS WEEK

China opens the door to fossil hunters

Ian Anderson, San Francisco

A REMOTE part of China, rich in the fossilised remains of dinosaurs, is being opened up to scientists from the West for the first time since the revolution there in 1949. A team of eight Canadian scientists who will work with the Chinese left Calgary in Canada this week to begin its two-month expedition. It is said to be the largest palaeontological expedition ever undertaken in China.

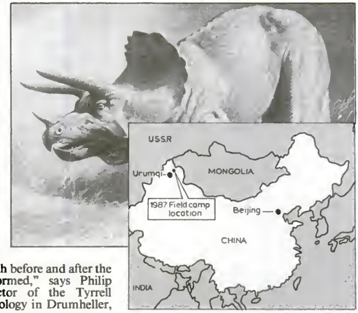
The scientists expect to find new species of dinosaurs and, possibly, new genera. The work will also expand knowledge about the migration of dinosaurs over vast distances.

China and Canada were once joined by land. "We will be able to compare how the dinosaurs evolved both before and after the land bridge was formed," says Philip Currie, acting director of the Tyrrell Museum of Palaeontology in Drumheller, Alberta.

Together, Canada and China account for about half the known species of dinosaurs. Northern China, which remained dry as floods covered the ancient land masses of North America and China, may even provide a complete record of dinosaur evolution.

"We want to make sure that our data do not conflict," Currie said. "If the specimens in the two places [Canada and China] are related, it's important to make sure we are doing the same thing."

All told, 11 Canadians and about 30 scientists from the Chinese Academy of Sciences will take part in the research. The research site is in the Gobi Desert in the far northwest of China near the ancient ruins of Jiangjunmiao. The closest city of any size is Urumqi, about 350 kilometres away. The area is especially rich in bones from the Jurassic and early Cretaceous periods, between 150 and 100 million years ago.



Triceratops roamed North America 70 million years ago. Did it come from China?

The Canadians regard their participation in the research as a scientific coup. Seven other groups, including scientists from the British Museum in London, the American Museum of Natural History and France's Musée Nationale d'Histoire Naturelle, had wanted to participate with the Chinese. Palaeontologists from the Natural History Museum in London have been working further to the east in Sichuan province.

The Chinese chose the Canadians partly because they offered Chinese researchers a chance to work in Canada. Last summer, a team of Chinese scientists joined excavations in the badlands of Alberta and in the far north of Canada on Ellesmere Island and on Axel Heiberg Island.

An eight-year agreement called the Canada-China Dinosaur Project has been signed between the Institute of Vertebrate Palaeontology and Palaeoanthropology of the Chinese Academy of Sciences, and from Canada the Tyrrell Museum, and the National Museum of Natural Sciences in Ottawa.

The participants will hold field trips regularly in both countries. They will make at least three expeditions to China, including one next year to Inner Mongolia. The bones that they find will form the basis of an exhibition that will tour the world in the 1990s.

China can help fill the gaps in the patchy North American record of dinosaur evolution. Alberta is especially rich in bones from the late Cretaceous period, about 80 million years ago. This is when the land bridge across what is now the Bering Strait is believed to have formed. It remained until after the dinosaurs died out about 65 million years ago.

Currie and other scientists believe that plant-eating dinosaurs moved in herds of up to 10 000 animals. They expect to find specimens in China that are the same as or similar to North American specimens. Some species are believed to have migrated both to and from China. ☐

OBSERVER David Austin
THEY'RE YUPPIES CHANTING FOR A BULL MARKET'
USHER IN THE AGE OF AQUARIUS
BRING ON THE AGE OF TAURUS

Handsets across the sea

BRITAIN'S two existing operators of cellular radio have won the right to run the United Kingdom's part of the planned European cellular radio-telephone service.

Racal Vodafone and Cellnet (which is owned by British Telecom and Securicor) are due to sign a memorandum of understanding with other European countries to synchronise in 1991 the start of the pan-European service, based on digital technology.

The British government said last week that the two companies, which have run the national cellular radio service since 1985, would between them be allocated 400 radio channels held in reserve for the European service. It added that it has no plans at present to grant a licence to a third national cellular radio operator.

The pan-European service will allow the owners of cellular radios to use their machines throughout Western Europe and Scandinavia. Today, a British user would find his handset useless on journeys to France, for example or if he or she wanted to telephone abroad from Britain.

In Britain, the government has allocated a 25-megahertz band of frequencies for transmitting and receiving cellular calls. Of this, 15 megahertz is used in Britain and the other 10 megahertz is reserved for the pan-European service.

In the national system, each user takes up 25 kilohertz for his conversation. In the European system, the 10 megahertz will be divided into bigger slices—200 kilohertz rather than 25. But a technology called "time division multiplexing" will allow eight telephone calls to be going on at once in each of the frequency slices. The user will not be aware of this.

Already, cellular radio in Britain has 200 000 subscribers and is available to 90 per cent of the population. In London, in particular, the service is so popular that it is becoming congested. Some extra frequencies are to be allowed next year to help the situation in the capital, but even so, the companies expect their capacity to be saturated by 1992. ☐

Radon peril haunts US homes

A SURVEY of 10 states in the US suggests that in a fifth of all American households, levels of radon gas exceed those that are considered acceptably safe. The gas, produced by the decay of uranium in rocks and soil, breaks down quickly to form radioactive particles that increase the risk of lung cancer.

The US's Environmental Protection Agency considers 150 becquerels per cubic metre of air to be the maximum permissible average level for airborne radiation in homes. Of the 11 600 homes surveyed by the agency, 21 per cent had radon levels higher than this. One per cent had levels five times higher or more.

James Barnes, the deputy administrator at the agency, said that "radon may be a problem in virtually every state".

Though geology proved to be a good indicator of areas at high risk from radon, the two states with apparently the lowest risk had the survey's highest concentrations in individual homes. High average levels tend to correlate with known deposits of uranium and black shale. In Colorado, almost 40 per cent of homes had radon levels above the protection agency's limit. The state is a centre of uranium mining. Parts of Grand Junction in Colorado are built on tailings from the uranium mines.

The two peak individual concentrations occurred in homes in Alabama (6000 becquerels per cubic metre) and Michigan (6700 becquerels per cubic metre).

In the light of the results of the survey, the American Medical Association is campaigning for more research into the risks to health of inhaling radon and its decay products. Also it wants to highlight the problems for doctors in recognising the symptoms of radon exposure. The association's Council on Scientific Affairs made its recommendations in a recent issue of the *Journal of the American Medical Association* (v 258, p 668). □

New test to catch noisy bikers

Sally & Richard Greenhill

Muzzle your motorcycle or fall foul of the law

A SIMPLE, new device could help police to spot and successfully prosecute motorcyclists whose machines exceed legal noise limits.

Existing legal controls on motorcycles are lax. The National Society for Clean Air's noise committee estimates that about a third of Britain's 1·2 million motorcycles are illegally noisy.

Manufacturers of the machines are required under EEC law to test the motorcycles for noise before they leave the factory. However, silencers on the motorcycles frequently deteriorate during use. Some riders deliberately remove internal noise baffles to make their machines more rowdy.

The present test involves accelerating a suspect machine over a 20-metre course. Two microphones register the noise. This test is repeated five times and the lowest reading is taken. No police station in Britain is equipped to carry out this test. In practice, noisy motorcyclists are only prosecuted when police notice that a silencer is not working—if it is hanging off the motorbike, for example.

The new test, developed by Derby City Council's environmental health department, is a modification of the EEC's test for motorcycles as they leave factories. The machine is mounted on a stand and accelerated to half-throttle. A microphone is placed 0·5 metres away from the silencer at an angle of 45 degrees.

The council checked 110 motorcycles. It found that 95 per cent of the machines with standard silencers in good condition passed the test. Of the motorcycles without standard silencers, or with silencers in poor condition, four-fifths failed the test. □

Japanese to test the home comforts of 'telecommuting'

EMPLOYEES of 20 companies in Japan are to taste the experience of working from home instead of trekking daily to the office. As part of a study into telecommuting, a new phrase to describe working from home, the employees will go about their daily business of product planning, real-estate management or financial consultancy seated at computer terminals in their living rooms.

The aim of the study is to see how people respond psychologically to working away from the office, and how the isolation affects the quality of their work.

Another objective is to make life easier for Japan's increasing proportion of elderly citizens. If they can work from home, they are spared difficult journeys commuting to work. Another potential benefit is to ease pressure on office space in crowded city centres.

The main driving force behind the project is Sumitomo Trust and Banking. Each company will pay £100 000 and in return receive telecommunications equipment for employees taking part.

Sumitomo says that the scheme is unique because it investigates people with important jobs and is not restricted to companies engaged in advanced technology. □

Aborigines rebuff NASA

NASA is to modify its planned space programme at Woomera in South Australia following the refusal by local Aborigines to allow scientists access to their land (*New Scientist*, 30 July, p 21). NASA had planned a series of rocket launches which would have passed over the land. New trajectories are now being worked out for six rockets and the first launch has been delayed by a month to mid-November.

A series of launches by West Germany will go ahead as planned later this month at Woomera, as the trajectories do not cross land belonging to the Aborigines. The rockets will carry scientific payloads to investigate the newly discovered supernova, 1987a. □

Airships to detect missiles

THE US Air Force may decide to follow the US Navy and order an airship. In June, a British-led consortium of Airship Industries and Westinghouse won a $170 million contract to build an airship for the navy. The airship will be tested as an early warning system.

Now, the air force is also interested in an early warning system. Last week the air force's scientific advisory committee told the chief of staff, General Larry Welch, that the airship could supplement the existing AWACS (Airborne Warning and Control System).

The committee believes that airships, with radar mounted inside them, could be put on "picket duty" along the US coast line to detect cruise missiles. □

Clash over pesticide

THE Environmental Protection Agency in the US has refused to ban household sprays that kill termites—even though the chemicals involved, chloridine and heptachlor, have been shown to cause cancers, nervous disorders and liver damage in humans. Also, they contaminate cattle feed, cattle and human mothers' breast milk.

Environmental groups want the chemicals banned altogether, but an agreement reached last month between Velsicol, the only company in the US that manufactures them, and the agency, stops short of this.

The agency told Velsicol that it can resume selling the chemicals provided that it can develop safer ways for consumers to apply them. At present, airborne residues of the chemical remain indoors after spraying.

The chemicals have been used for more than 40 years in more than 24 million households in the US. The agreement also permits distributors and pest controllers to exhaust their existing warehouse stocks of the chemicals. □

Sheepish about caesium

SIXTEEN months after the Chernobyl accident left radioactive caesium spread across the uplands of Britain, government scientists say they are still unsure how long the radioactivity will cling to the hillsides, creating problems for sheep farmers.

Last week, Whitehall imposed a further clutch of controls on the movement and slaughter of sheep in Wales and Scotland. In total, around 550 000 animals on hill farms in Scotland, Wales and northern England are affected.

Scientists from the Ministry of Agriculture, Fisheries and Food, who are coordinating research into the behaviour of radioactive caesium in upland soils, refuse to say when they will have sufficient data and knowledge of the mechanisms involved to produce a model predicting the caesium's presence in soils, grass and sheep in future years. The problem is that in poor peaty soils the caesium stays mobile. There is no clay to immobilise it.

A spokesman for the ministry said that this week: "We should be in a better position once we have evaluated the results of the summer surveillance carried out by the Institute of Terrestrial Ecology." □

Rising hopes for male contraceptive

Sharon Kingman

A CONTRACEPTIVE pill for men is now nearer to reality. Doctors in eight centres around the world have asked 100 couples to take part in trials of a new hormonal contraceptive.

One of the eight centres is the Medical Research Council's Reproductive Biology Unit in Edinburgh. Fred Wu, who is organising the trial at the unit, says that he hopes to recruit 30 couples in the Edinburgh area. The men that take part will visit the unit weekly for an injection of male hormone.

To be eligible, each couple will have to have had at least one child already, to prove that they are fertile together. The woman must be less than 35 years old. Although the trial will take four years to complete, each couple will be asked to participate for only 12 months. They must agree not to use any other method of contraception.

Wu says that once researchers know whether the method is effective, they will arrange a larger study. A weekly injection is not a practical way of delivering the hormone. In future, scientists may develop either an injection that the man would have every three or four months, or a pill.

The hormone in this study is testosterone. It suppresses the hormones from the pituitary, the gland at the base of the brain that controls the sex hormones and normally stimulates the production of sperm. Most men who take the preparation stop making sperm altogether. The rest, Wu says, produce only half a million to a million sperm a day instead of the usual 200 million. In the laboratory, the sperm of these men has proved unable to fertilise eggs.

Fears that the contraceptive could diminish a man's virility are unfounded, Wu says. Testosterone is the hormone that determines the secondary sexual characteristics, such as growth of beard and deepness of voice. So extra testosterone is unlikely to have a detrimental effect. Conversely, Wu adds, there is no evidence that the preparation heightens sexuality.

Wu says: "If all goes well with this trial, and we get appropriate support, then it will be 10 to 15 years before anything will be available on prescription." □

Fishy cure for heart flutters

IF YOU want to reduce your chances of having a heart attack, eat fish. This is the message from a group of researchers in Australia who fed fats from different sources to rats.

Peter McLennan, a senior research scientist at the Commonwealth Scientific and Industrial Research Organisation's division of human nutrition, presented the results earlier this month at a conference in Australia. He and his colleagues fed the rats on four different diets. They contained saturated fats from animals, unsaturated fats from fish, unsaturated fats from plants and mixtures of all three.

The results suggest that polyunsaturated fats from fish are better than fats from other sources at reducing disturbances to the rhythmic thumping of the heart. These cardiac "flutters" often precede or bring on sudden cardiac arrest. "We obtained surprising results that even we were sceptical of initially," said McLennan.

The research team repeated the results a number of times to confirm their accuracy. They fed the rats on various diets, then artificially triggered heart rhythm disturbances. They observed whether diet influenced the incidence or duration of the flutters. Fewer of the rats on polyunsaturated fats reacted to the trigger. Those that did, recovered from the disturbances sooner than those groups fed with saturated or mixed fats.

In one test, the disturbances were far more severe, both in incidence and in duration, when rats were fed on polyunsaturated fats from vegetables rather than from fish.

The researchers conclude that by eating more polyunsaturated fats, particularly from fish, people at risk can reduce their chances of suffering sudden cardiac arrest. They suggest that the fats may alter the composition of heart muscle cells, making them less prone to rhythmic disturbances. □

Pearly prospects for oysters

EUROPEAN oysters cultivated on the Northwest coast of the US may be the answer to the prayers of oyster-catchers. Britain's oyster fishery, based on the European flat oyster *Ostrea edulis*, was all but ruined in the early 1980s by a disease called bonamiasis. *Bonamia*, a protozoan parasite, invades the oyster's blood cells and destroys its immunity. The disease devastated continental oyster beds in the late 1970s. In 1981 it reached the River Fal in Cornwall. By 1983 it had finished off the world's finest oysters—from the West Mersea beds in Essex.

Oyster growers began to cultivate instead the Pacific oyster, *Crassostrea sigas*, which is not so tasty but is resistant to *Bonamia*. Unfortunately, Pacific oysters suffered from other problems. If the water they grow in is contaminated with antifouling paint they grow misshapen and are not fit to sell.

Researchers at Battelle's Marine Research Laboratory in Sequim, Washington, in the US, have now found a local strain of the European flat oyster that is resistant to the disease. Ralph Elston of Battelle hopes that European countries might be able to revive their oyster fisheries with stocks from Washington. □

Parachute jumps are heart-stoppers

Geronimo! I can feel the blood pounding my temples

THE SHEER terror of a first parachute jump from an aeroplane is now recognised by medical science. The physiological responses of eight novice jumpers suggests that it is a sport ill-suited to anyone with even a touch of heart disease.

Doctors from Birmingham General Hospital charted the changes in heart rate and biochemistry during the jumps. All eight people (two women, six men) showed a peak in heart rate of some 160 beats per minute as they jumped. The "stress" hormones, adrenaline and noradrenaline, in their blood increased fivefold as they prepared to jump, and on landing. Most worrying, perhaps, was the discovery that the jumpers' blood was awash with free fatty acids—at concentrations high enough to have caused dangerous abnormalities in the rhythm of the heart beat.

"Doctors asked to perform medical examinations to assess fitness to jump should be aware of the extreme nature of the stress of parachute jumping," the researchers concluded in the *British Medical Journal*. □

Australian tax holiday sends R&D soaring

Jane Ford, Canberra

AN AMBITIOUS Australian plan to increase spending by industry on research by offering large tax incentives has borne fruit. But there are fears that industrialists may have made money by exploiting loopholes. The success of the scheme is bound to be looked at with interest in Britain, where the government is anxious about low spending by firms on R&D, despite rising profits.

The Australian federal government introduced a 150-per-cent tax concession two years ago for industrial R&D. The aim was to raise spending on R&D by firms, which had reached a record low in the early 1980s, in terms both of manpower and spending.

Spending by the private sector amounted to less than a fifth of total expenditure on R&D and the industrial research workforce had dropped by five per cent between 1982 and 1984.

The first figures on the impact of the concession were released last month by the government's Bureau of Statistics. They show spending of A$921 million, a 25-per-cent increase compared with the previous year. Overall spending on R&D in Australia in 1985/86 was A$2720 million. Of this A$1044 million was spent by the federal and state governments and $708 million by other bodies.

The tax concession is estimated to have cost the federal government around A$140 million in lost revenues in 1985/86 and is expected to cost around A$200 million in 1986/87. The loss is less than the initial calculations, which forecast that spending on industrial R&D would increase by 40 per cent in the first year of the scheme, losing A$180 million in revenue.

The less spectacular rise was, in the event, a relief to the government, which had feared an epidemic of tax frauds and creative accounting schemes.

Ministers believe that almost all loopholes for tax abuse have been removed and they hope that R&D spending by industry will now increase steadily over the remaining four years of the life of the tax concession, when its effectiveness will be reviewed. It is estimated that spending will rise to A$1030 million in 1986/87.

In order to take advantage of the concessions, companies register with the Industrial Research and Development Board and fill in a registration form giving details of their present and proposed expenditure on R&D and the type of research they are engaged in. Currently, 2200 companies are registered. The tax office makes a final decision on whether claims are eligible.

Companies must spend more than A$50 000 on R&D to be eligible for the concession, although smaller amounts of work can be contracted out to approved research institutes.

Buildings and equipment whose cost can be recouped under the concession must be wholly used for R&D. Some activities, such as the development of in-house software, are specifically excluded.

The tax concession is restricted to incorporated companies, although a number of syndicated R&D funds are being set up to allow unincorporated companies to benefit. These have yet formally to win the approval of the authorities, however.

One anomaly that has shown up in the first figures is that the substantial increase in spending on R&D has not brought a similar increase in the size of the research workforce. There is some speculation that some of the larger companies are investing in R&D buildings and plant, without actually doing a lot of research inside the buildings.

This is because the concession only requires buildings and plant to be designated for R&D use for five years. After that, they can be turned over to some new purpose. This potential loophole is currently being looked at by the government. ☐

Cookies for koalas

KOALAS in zoos around the world will soon have a new delicacy to tempt their palates—gumleaf biscuits. Ian Hume, professor of biology at Sydney University, is trying to develop a satisfactory artificial diet for koalas, which are renowned for their fussy eating habits. He hopes to produce a gumleaf biscuit for sale to international zoos that have difficulty getting fresh supplies of eucalyptus leaves.

He has been working on the project for 18 months and in the past four months has managed to persuade six koalas to cut their intake of fresh gumleaves by half. ☐

Famine hits Ethiopia

ETHIOPIA has admitted that it could be facing a famine as severe as the one in 1984. The announcement followed earlier denials by Ethiopian authorities that a dry spell in the northern provinces of Tigre and Eritrea could result in famine (last issue, p 26).

Berhanu Jembere, the head of Ethiopia's Relief and Rehabilitation Commission, told representatives of donor nations and aid agencies in the Ethiopian capital, Addis Ababa, that crops have now failed completely in some of the country's major farming regions. Efforts to replace the crops with varieties that could ripen quickly once the rains resume have largely failed.

Michael Priestley, of the UN Development Programme in Addis, estimates that Ethiopia may need up to 2 million tonnes of emergency grain over the next year. This is approximately the same deficit of food the country experienced in 1985, at the height of the last famine, and four times the amount of aid Ethiopia thought it would need a month ago.

The Ethiopian government called for a "quick and timely" response from the international community to the renewed threat of famine. At present, Ethiopia has less than a quarter of the emergency reserves it says it needs to cover the period between requests for aid, and the first arrivals of grain. Only half of its requests for food this year had been met by donors, before the rains failed in July. ☐

● **Ethiopia's grains of hope, p 20**

Fast trains to take on the outback

SNCF

AUSTRALIAN companies want to build the fastest train in the world, to run between Sydney and Melbourne. The plan, from a private consortium including a Japanese construction group, Kumagai-Gumi, is for almost 900 kilometres of new track, carrying trains at up to 350 kilometres per hour—faster than the world's current fastest train, the French TGV (*above*).

Work could start on the $4-billion project in 1989 and be completed by 1995. It would provide a three-hour train service between the two cities.

The train was first proposed three years ago by Paul Wild, a former chairman of the Australian government's research organisation, the CSIRO. A new study will assess its economic prospects. ☐

Dredgers scrape barrel in quest for gravel at sea

Roger Milne

BRITAIN's construction industry is in danger of running out of stretches of sea bed where it has permission to excavate sand and gravel. Ironically, this is happening just as the government seeks ways to increase the use of marine aggregates to help preserve the English countryside.

Whitehall is looking urgently at ways of easing the complex licensing system which controls the availability of offshore sand and gravel. For the first time, it is contributing to a pilot survey of reserves which will be the forerunner of a comprehensive national assessment.

A team from the British Geological Survey is currently investigating how much mineable sand and gravel lies off the coast of East Anglia. A report should be ready by the end of the year.

Government action has been prompted by a report commissioned by the Department of the Environment. This warned that "in the medium to the longer term, seabed resources are not secure enough to meet national needs". The report was completed recently by two companies, C & C Mineral Planning Services and Sea Sediments Survey & Consultancy.

The authors, Robert Nunny and Patrick Chillingworth, warned that the position has become worse over the past 20 years because existing offshore supplies are being depleted faster than permissions for new workings are granted.

The problem is at its most acute in South-east England, where reserves could run out within 6 to 9 years unless immediate action is taken. The region is undergoing a construction boom which is stretching existing onshore reserves. New power stations, major developments in London's docklands and the Channel Tunnel project underline the growing demand for aggregates.

The problems associated with working sand and gravel pits on land—noise, dust, land dereliction and the movement of fleets of heavy lorries—makes the use of offshore reserves an increasingly important environmental priority.

According to government policy, aggregates dredged from the seabed should supply around one-fifth of the needs of the building and construction industry. Yet, at present, marine dredgers provide only about 12·5 per cent of Britain's aggregates. But this still makes it a large business.

Total landings in Britain are around 12 million tonnes. The industry lands a further 3 million tonnes at other European ports. Only in Japan does the construction industry use larger amounts of marine aggregate. The quantity brought ashore in Britain matches the production of aggregates from some 240 hectares of land workings.

In Britain, there are six main dredging areas. They are off the east and south coasts, the Thames Estuary, the Bristol Channel, the Humber, and Liverpool Bay.

The greatest amounts of sand and gravel come ashore on the east and south coasts. Around two-thirds of all dredged material arrives at wharves in Southeast England.

In Wales, and along the west coast of England, suppliers land much more sand than gravel, principally at wharves in South Wales. Dredgers do not operate at present in Scottish waters.

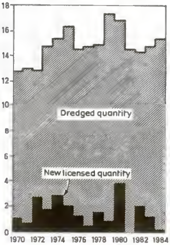
The report says that many of the potential locations for dredging have become "no go" areas because of fears for the effect on coastal stability and vital fisheries. The presence of underwater cables and pipelines has forced other reserves to stay untapped.

The report revealed both that depletion outstrips the licensing of new marine reserves, and that the full amount of potential aggregate reserves on the seabed is unknown.

Nunny and Chillingworth told Whitehall: "Total aggregate availability, both licensed and unlicensed, is uncertain due to the difficulties of recovering data in the adverse offshore environment . . . little is known about the extent of offshore resource availability."

The report adds: "If government objectives regarding the future increased use of marine aggregates are to be achieved, then major decisions will have to be made at national level to release substantial offshore reserves."

The authors point out that "the problem is heightened by the fact that the total quantity dredged each year has, at least since 1965, greatly exceeded the additional quantities that have been licensed . . . resulting in a serious depletion of offshore licensed reserves."



In Britain, the Crown is responsible for licensing the extraction of offshore deposits of sand and gravel, through the Crown Estates Commissioners. Two sorts of licences are needed; one for prospecting and one for extraction. The sys-tem for obtaining an extraction licence is cumbersome, archaic, longwinded and prone to secrecy.

Up to seven Whitehall departments may consider a single proposal. So may the relevant coastal protection authority and regional water authority. Other bodies, including the Nature Conservancy Council and Trinity House, which is responsible for safeguarding navigation, may also become embroiled in individual schemes. The Crown Estates Commissioners use a firm of consultants, Hydraulics Research, to advise on the likely impact on coastal stability of dredging proposals.

All these consultations are carried out in secret and can take more than two years to complete. Suppliers of aggregates have no chance to appeal against refusal of a production licence.

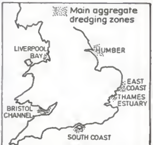
This process contrasts with what happens onshore, where proposals to extract sand and gravel are the subject of public debate through the planning process. Normally, this takes only a fraction of the time required for approvals for marine dredging. The report argues strongly that it makes sense to include planning authorities in the marine system—a proposal which the government is currently trying to find ways of accommodating.

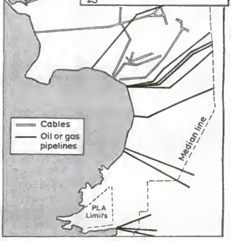
The authors of the report suggest a better programme for data generation, basic research and site monitoring to counter what they see as overprotective claims by coastal authorities and fishery interests.

In the case of the reserves that are easily accessible from wharves on the Thames Estuary, the report estimates that there is a potential of 50 million tonnes currently "frozen" by concern for coastal stability and fisheries.

The report acknowledges that the problem caused by pipelines and cables in the southern North Sea (see diagram) will continue to block prospecting for aggregates. Around 1000 kilometres of active cable has been laid in that part of the North Sea. Because of the need to leave a protection zone around cables and pipes, some 3600 square kilometres of seabed has effectively been frozen.

This represents one-tenth of the seabed within reach of modern dredgers. These operate at depths of between 15 and 35 metres. When conflicts arise with fishery interests, one of the major problems is that herring prefer to lay their eggs in well-sorted gravel during spawning. The report calls for more detailed research into the spawning habits of herring, as well as the impact on crustaceans of dredging. ☐





There's plenty of gravel in the North Sea, but cables obstruct access to it

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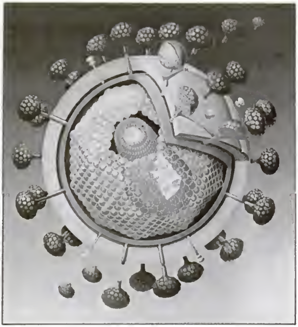
AIDS MONITOR

The search is on for key peptides



M G Koch/H. R Gelderblom/P A Marx

Portrait of a virus: its proteins may lead to a vaccine

WORK has begun in Britain to determine which part of the human immunodeficiency virus (HIV) will prove to be a good candidate for a vaccine. Scientists need to identify a component of the virus, probably a protein, which will induce a protective immune response when injected into humans.

Many groups are concentrating on proteins that sit in the viral membrane, the envelope glycoproteins, gp120 and gp41, which are subunits of a protein called gp160. As part of the Medical Research Council's directed programme of research on AIDS, several companies and research teams have received grants to carry out work on the role of these viral molecules in stimulating immunity.

The Medical Research Council (MRC) is paying two companies to produce some of the raw materials that scientists will need in the pursuit of a vaccine. A biotechnology company, Celltech, will supply researchers supported by the council with quantities of gp160. A second firm, Cambridge Research Biochemicals, is making peptides (short segments) of gp160.

Celltech hopes to begin manufacturing the proteins in bulk by the beginning of next year. The company will grow the proteins in cells taken from the ovaries of Chinese hamsters. The technique involves inserting the genes for the proteins into these cells. The company then grows the cells in bulk in giant fermenters at its factory in Slough.

Peter Lachmann, director of the Mechanisms in Tumour Immunity Unit in Cambridge has already begun to use the peptides manufactured by Cambridge Research Biochemicals. Each of the 86 peptides is 15 amino acids long. The sequences of amino acids of "adjacent" peptides overlap so that every part of the protein is represented twice.

Lachmann and his colleagues will inject these peptides into rats to test the animals' ability to recognise the peptides as foreign and to produce antibodies against these molecules. The aim is to identify which part of gp160 causes the host animal to produce antibodies that bind to the part of HIV which recognises the human T4 cell. Such antibodies would block the binding of the virus to the receptor on the T4 cell, the white blood cell that HIV attacks.

Lachmann says he has already carried out a pilot study with about 10 peptides. He began the full study last week. If any of the peptides prove to be good candidates for a vaccine, Lachmann adds, the next stage will be to test them on himself and his colleagues to see how good the segments of protein are at raising antibodies in humans. Researchers will then test the most promising peptides on animals, possibly chimpanzees, to see whether they can fight off a deliberate infection with live virus. If they can, this will suggest that the vaccine might work in humans. Clinical trials would be the next step.

The problem with HIV is that one virus, or "isolate", differs markedly from another. A vaccine that proves effective against one isolate may not work against another. Lachmann says that all the MRC's researchers are using a single isolate, so that different groups of researchers can easily compare results.

Other researchers will work with whole gp160 and gp120 proteins. "The question," Lachmann says, "of whether whole protein or peptides will prove the best vaccine is quite imponderable."

Researchers are also looking for a vaccine that causes the host to produce antibodies that help other proteins important in the immune system, called complement proteins, to destroy the virus. It seems that when certain antibodies bind to viruses, other proteins begin to break open the virus so that an important enzyme leaks out. Without this enzyme, called reverse transcriptase, the virus cannot insert its own genetic information into that of the T cell. □

Second virus reaches Brazil

DOCTORS have isolated the second strain of the human immunodeficiency virus, HIV-2, in Brazil. Ricardo Veronesi, together with colleagues in Brazil and Portugal, say that they have found evidence of infection with HIV-2 in stored samples of sera. They had originally taken this blood, in 1986, from 73 individuals—homosexuals, transvestites or intravenous drug abusers—of whom 42 per cent had antibodies to HIV-1.

This year, the researchers tested the stored samples again. Four people had antibodies to HIV-2, two of whom also had antibodies to HIV-1 (*The Lancet*), 1987, vol II, p 402). All four subjects, they say, were healthy when they gave blood samples in 1986. On average the four had 28 partners each week. Condoms are rarely used.

Veronesi and his colleagues suggest that blood banks should now screen for HIV-2 as well as HIV-1. □

Acknowledgment and action in Eastern Europe

THE Soviet Union is preparing a massive information campaign on AIDS. Valentin Pokrovsky, President of the Soviet Academy of Medical Sciences in Moscow, says that the first 10 million pamphlets are ready for distribution. The aim is to reach "every enterprise, school and home", he says.

According to official figures, 54 people have had positive results to the test for antibodies to the human immunodeficiency virus (HIV). But, as in most East European states, this figure is probably a serious underestimate.

The Soviet Union is making a disproportionately large contribution—$1 million in 1987—to the World Health Organization's programme on AIDS. In addition, the Politburo is taking steps to control the spread of the virus within the country's borders. Legislation already exists that makes it an offence knowingly to pass on the virus to another person.

All foreigners living in the Soviet Union are to have compulsory tests, as are people in high-risk groups. Identifying individuals in high-risk groups will not be easy, however. Homosexuality is still an illegal activity, and carries a maximum prison sentence of five years.

Tass news agency says that the national programme will provide a network of specialised laboratories for the diagnosis of HIV infection and monitoring the spread of the virus. Until recently, the Soviet Union had to import tests for antibodies to HIV, but researchers have now developed domestic tests.

Despite Mikhail Gorbachov's glasnost, the Soviet Union has been slow to respond to the problems posed by AIDS in comparison with some East European countries. In Eastern Europe, however, the general pattern now emerging suggests that the theory that AIDS is a disease of capitalist countries no longer applies. ▸

▸ Hungary has reported 123 individuals who are HIV-positive, and has acted swiftly to deal with the problem. Free screening is now available to those who want it. In addition, hundreds of thousands of blood donors have already been tested. Hungary will begin producing tests for HIV antibodies under licence from the Dutch company Organon by the end of this year.

In Poland, lack of money is proving to be a serious problem. The government cannot afford to import expensive tests from the West. Disposable syringes are also in short supply. Jerzy Bonczak, a deputy minister of health, has special responsibility for issues related to AIDS. Experts believe that the figures he has recently released are wildly inaccurate.

Bonczak says that there are 29 HIV-positive people in Poland, four of whom have developed AIDS. There have been two deaths from AIDS since March, Bonczak says. Of all the industrialised countries in Eastern Europe, Poland is probably the one least able to monitor the spread of HIV.

TASS

A Russian doctor tests a blood sample for HIV

Albania, in its splendid isolation, can probably still claim to be the only country in Europe that is free from AIDS. Even secretive Rumania has admitted to its first cases. Petre Ciobanu, a senior civil servant in the Health Ministry, admitted in May to two deaths related to AIDS and a further 13 people who are HIV-positive.

Should HIV infection gain a firm foothold in Rumania, it could spread dramatically. The country has no money for either tests or needles, and standards of hygiene in hospitals are minimal. Furthermore, condoms are available only on the black market.

All East European countries are taking a tough line against foreigners. Almost all have registered cases among their large populations of African students. ☐

Breast is best, but milk may pass on the virus

A WOMAN infected with human immunodeficiency virus (HIV) may pass on the infection in her breast milk—even to a child that was not infected at birth. Two recent case reports suggest that this route of infection may be possible (*The Lancet*, 1987, vol II, p 400).

The doctors and researchers say that their report should not discourage mothers from breast-feeding even in countries where HIV infection is common. But they conclude that if other workers confirm their findings, "measures to avoid contamination of banked breast milk should be enforced".

The researchers, led by Philippe Lepage of Kigali in Rwanda, came across the two cases during a study of HIV infection in children. From February 1984 to January 1986, the team diagnosed 107 cases of AIDS and AIDS-related complex in children. Of these, 88 had become infected before or at birth. Eight had an uninfected mother and a history of blood transfusion. In nine, the cause was unknown. The remaining two children may have become infected from breast milk.

The first case was in a child born to healthy Rwandese parents. The mother lost a lot of blood after giving birth, and received two units of donated blood—her first blood transfusion—a day later.

The child fell ill at the age of 10 months and died at the age of 19 months. She had antibodies to HIV.

The mother had been breast-feeding her daughter. One theory has been that an infant might become infected if the mother has cracked nipples. In this case, however, there had been no nipple problems.

The mother began to show signs of HIV infection a year after the birth. She also had antibodies to HIV. She denied having sexual contact with anyone other than her husband, or using intravenous drugs. Her husband was seronegative for HIV. The researchers traced the two blood donors: one was HIV-positive.

The second case was almost identical. Both women had received contaminated blood in a transfusion after delivery. Both husbands were seronegative. Lepage and his coworkers say: "The evidence strongly suggests postnatal maternal-child transmission in these two cases."

In a second letter to *The Lancet* (1987, vol II, p 401), Naomi Baumslag of Georgetown University Medical School in Bethesda, Maryland, warns against making hasty recommendations on the risks of transmission via breast milk. She says: "Where breast-feeding is a matter of life and death, public health recommendations must be based on fact not theory. In developing countries the major cause of death is diarrhoeal disease, not AIDS." ☐

Many cases missed, says GP

FAMILY doctors may be failing to identify many cases of AIDS. Andrew Heley, a general practitioner in London who looks after several patients with AIDS, says, "I am absolutely certain that many cases are being missed. General practitioners are not recognising the early signs and symptoms because AIDS presents as a thousand other diseases."

Heley has recently seen two patients from the Hornsey area of London who had visited their general practitioners with symptoms of pneumonia caused by *Pneumocystis carinii*. Yet their general practitioners diagnosed neither pneumonia nor AIDS. Both patients left their general practitioners' lists without telling the doctors why. So the doctors are ignorant of their errors.

Pneumocystis carinii pneumonia, or PCP, can be one of the first signs of AIDS. Heley believes that people who know that they are at high risk of having HIV infection should be aware of the symptoms of PCP. PCP causes a dry unproductive cough which lasts for weeks. The person suffers increasing shortness of breath. Heley emphasises that anxiety can mimic many of the symptoms of AIDS and that anyone who is worried should seek advice. He is giving a series of seminars for general practitioners on 26, 27 and 28 August at the Prince of Wales Hospital in Tottenham, north London. ☐

Infection spreads in Ireland

NINETEEN PEOPLE have so far died from AIDS in the Republic of Ireland, according to official figures. Eleven of these deaths occurred after January 1, 1986. Over 500 Irish are also known to have antibodies to the human immunodeficiency virus (HIV).

Earlier this year, Rory O'Hanlon, the Irish Minister for Health, said that of the 11 people who had recently died, five were either homosexuals or bisexuals who had caught the infection through sexual contact with an infected person. Three cases were related to drug abuse, and three were haemophiliacs. One of the haemophiliacs was a practising doctor. At least 20 of the 500 people who are HIV-positive are babies born to mothers who used intravenous drugs. ☐

Help for African states

THE World Health Organization is making US$13 million available to four African countries for programmes to control AIDS. Ethiopia, Kenya, Rwanda and Tanzania all now have five-year plans endorsed by WHO—and the money to carry them out. The decision follows a series of meetings, one in each country, organised by WHO and the Ministry of Health concerned. These meetings were necessary, says WHO, because of the magnitude of resources required and because countries need to avoid diverting scarce resources from other important health programmes. WHO, with the Ministry of Health concerned, has set up a national management committee in each country, to coordinate the programme. ☐

British cases rise above 900

THE NUMBER of cases of AIDS in Britain has risen to 906, an increase of 64 during July. Deaths have gone up from 490 to 529, says the Department of Health and Social Security. One of the deaths was the child of a mother infected with the human immunodeficiency virus. There have so far been five deaths in this category. Of the 64 extra cases of AIDS, 55 were in homosexuals or bisexuals, and six were haemophiliacs. Two were heterosexuals "possibly infected abroad". ☐

AIDS Monitor is edited by **Sharon Kingman**, with contributions this week from **Steve Connor**, **Misha Glenny** and **Stephen O'Sullivan**.

Ethiopia's grains of hope

The rains failed in Ethiopia last month. Crops have died. New organisations set up to predict famine are sounding the alarm. But, if the worst happens, will the world respond any better than in 1984?

Debora MacKenzie

ETHIOPIA is once again asking the world to send it food. Drought and locusts have killed crops in many parts of the country, and famine looms.

During the last drought in Ethiopia, a million people died, mostly because emergency food did not reach them soon enough. This time, Ethiopia is issuing an early warning.

Many scientists are currently very keen on developing "early warning" systems to predict potential famine. The reasoning is that if scientists can sound the alarm early enough and convincingly enough, politicians and aid agencies will provide food in time to prevent tragedy .

Ethiopia recently set up its first countrywide network to collect the data that warn of famine. That system is swinging into action this week. A detailed estimate of how much grain the country will need, where and when, should be ready within a week.

The people in charge of the system say it will not prevent starvation. For that, rich countries have to respond to the warning. Ethiopia will soon find out whether early warning is really the key to eliciting that response. So far, the omens are poor.

Brehani Grizzaw, the head of early warning at Ethiopia's Relief and Rehabilitation Commission, says of the disaster in his country in 1984, "We had perfectly good predictions. The predictions didn't fail. The response failed".

The 80 per cent of Ethiopians who depend on the food they grow on their own fields, plus the 10 per cent who are nomadic cattle herders, are always at risk from famine. That is 40 million people. If the rains fail, crops and pastures die, and people starve. Every year, somewhere in Ethiopia, the rains fail.

An Ethiopian historian, Mocfin Woldo Mariam, has studied past Ethiopian famines. He estimates that a local drought occurs every year, regional drought happens every three or four years, and general, widespread drought comes every eight to ten years.

If nothing else, the next big famine will be exceedingly well predicted. In 1984, after television pictures from the relief camp at Korem created the public outcry that finally brought aid to Ethiopia, many relief agencies reminded the world that they had been predicting tragedy all along. Nevertheless, since then, some agencies have invested much money and effort into improving their predictive capability.

They say that if relief arrives before people start dying, preferably before they leave their villages to look for help in squalid, disease-ridden camps, drought need not result in catastrophe. But finding the villages on the edge of catastrophe is easier said than done.

Communication is difficult in the roadless mountains of Ethiopia. The patchy nature of rainfall can bring drought to one village, good crops to the next.

Photographs: Debora MacKenzie

Food will soon be scarce in this market at Mahal Meda, in northern Shoa province

Brehani sees his biggest job as monitoring the state of crops. He intends to assess the overall quality of the crops, instead of trying to predict the precise quantity of the harvest. Precise predictions of harvests can come too late to be of any use, he says. The UN Food and Agriculture Organisation (FAO) was criticised during the last famine for insisting on completing formal assessments before reaching the, already obvious, conclusion that there was trouble.

Once crop failure has been spotted, says Brehani, the next job will be predicting the effect. How many people will lose their harvest? Can they replant? Can they survive by selling their livestock? Do they have any stocks of food? Can they buy food?

One important tool will be monitoring the price of grain and livestock in markets. Prices rise quickly once shortages develop. The same observations will be made among nomads, substituting the condition and price of herds for those of crops. This will be difficult, says Brehani. Pastoralists and their markets are scattered and remote.

The Ethiopian meteorological service has about 1000 weather stations, but only 60 report monthly or more often. Now a donation from Canada will allow those stations to be automated and to submit daily weather reports by radio.

Ploughing in May near Debre Berhan, 100 kilometres north of Addis. The crop has died

The relief commission also plans to survey the health of children. Every three months workers will measure the height and weight of children in selected areas of all the vulnerable districts. Two British relief agencies, the Save the Children Fund and Oxfam, have been developing the methodology for this work since before the last famine in Ethiopia. They will start regular surveys in collaboration with the Ethiopian commission in November.

"What we lack now is not data, but the capacity to analyse it," says Brehani. To meet this need, more Canadian money is buying the team four microcomputers. One team-member, Melaku Ayalew, has trained in England to operate them. The computers will analyse statistically the economic and nutritional data and the crop assessments. The computer's graphic displays may reveal the first signs of disaster.

What happens then? Dag Hareide, who heads the Emergency Prevention and Preparedness Group organised by the UN in Addis Ababa, says: "In 1984 we had the early warning. But we didn't have the resources, plans or manpower to cope with the early warning." Workers in his group suspect that the preoccupation among some aid agencies with early warning "just adds up to a lot of people's PhD theses". Hareide says the real concern should be the ability to respond when warnings come.

In June this year, agricultural experts said that despite the good early rains, crops could still fail if the rains faltered. In July, the rain stopped falling in many places. Its return this month is too late to save some crops.

"The main reason people died in 1985 was logistics, things like transport and warehouses," says Hareide. He warns that the improvements made in these areas during the last emergency have not been maintained. "This year we have a trucking capacity of about 750 000 tonnes. That will go down by about 10 per cent a year." He says the next emergency could be much bigger than the last, and relief workers will have half the trucks they need.

Stocks of seeds are needed, too. Last year, a dry spell in the west of Ethiopia killed off varieties of sorghum and maize that require a long growing season. "If we had had reserves of short-season maize and sorghum seed," says Hareide, "we could have distributed it." The farmers could have replanted when the rains returned shortly afterwards. In that way "we could have avoided giving out 200 000 tonnes of food aid this year."

This year, July's dry spell killed some crops, and the FAO tried to fly in a variety of maize with a short growing season to replace dead crops. The seed was delayed in Kenya, and arrived too late to help.

This June, when food production was calculated at 99 per cent of "normal", more than three million people in pockets all over the country were on emergency relief. Now the failure of rains in the north may have doubled that figure. In June, the government calculated that it needed 736 000 tonnes of relief food for the second half of 1987. Three-quarters of that had to be brought into the country. So far, donor nations have pledged only 334 000 tonnes. No more has been pledged since.

If this week's warnings of potential famine are correct, then pledges would have to be shipped now to arrive in time. Much of what arrives could be too late to prevent people fleeing to relief camps.

It is clear that there is no substitute for stocks of grain within the country. "We are trying to increase our preparedness," says Brehani. Italy, Sweden and the EEC have all paid for new warehouses. But they stand empty. Brehani says he needs 180 000 tonnes of grain in warehouses to see the country through the first few months of an emergency, until relief arrives from outside. He has 42 000 tonnes. Most of it, he says, is from Canada and the World Food Programme. The EEC, which accounts for most British food aid, has contributed nothing.

The EEC is contributing to the emergency food being distributed now in Ethiopia. But, asks Lars Jacobson of the FAO in Addis, why are most rich nations only happy to give food once people are destitute? ☐

Meanwhile, India is prepared

WHILE a partial failure of the rains makes Ethiopia reel in the face of famine, one of the worst droughts in India's history is expected to result in no widespread famine at all. The difference is made by agricultural research, and by the sort of emergency stocks of grain the Ethiopians are trying to acquire.

Indian crops depend on the monsoon. For half the year, wet winds blow from the Indian Ocean, carrying the rain on which Indian agriculture is based. The wet monsoon usually starts sweeping across the subcontinent in June.

This year, the monsoon was extremely late, and in many regions it did not arrive at all. Especially hard-hit are the most northerly of the regions normally reached by the monsoon. The rain has failed to penetrate as far as Rajasthan in Northwest India for the past four years. This year, the monsoon has even missed regions further south.

Rajiv Gandhi, the Indian Prime Minister, said this week: "This is the most widespread drought we have had since independence", forty years ago. But, he said, "we now have the strength to keep the drought from becoming a famine."

That strength is based on the Green Revolution, a scientific effort in the 1950s and 1960s, which resulted in high-yielding, hardy strains of rice and wheat, specially suited to Indian conditions.

These strains have helped turn India from a victim of repeated famines to an exporter of food. They have also given India a stockpile of about 24 million tonnes of wheat and rice. It is this emergency reserve that should help Indian farmers through this year's drought with little or no starvation.

There is a pitfall in the system, however. The distribution of emergency stocks of grain in India is handled by private merchants. Famine experts at the UN office in Addis Ababa say that local markets have been shown in many countries to be the most efficient way to ensure distribution of emergency food.

The system depends on people's ability to buy, however. Farmers who cannot grow all their own food because of drought, normally earn money to buy food by taking work on farms that are better off. These can be farms in regions that have had rain, or farms that produce crops for export and can afford irrigation.

This year, the drought in India is so widespread that there are few regions where farmers can offer any jobs. The irrigation canals are running out of water.

Rajiv Ghandi says the most serious result of the failed monsoon will be that an estimated 15 million people in the rural areas become unemployed. He has good reason to worry. In the 1940s , a drought in the north of the country killed two million people. There was enough food in the country to feed them at the time; the people just could not afford to buy the food. ☐

SCIENCE

Sodium surge makes hearts flutter

PEOPLE who suffer a fatal heart attack die because the muscle of the heart fails to contract in a uniform manner. Instead of the muscle contracting rhythmically, forcing blood out of the chambers of the heart, it contracts without any rhythm. During a heart attack the muscle fibres pull against each other instead of cooperating to close the heart chambers and drive blood around the body.

"It's a bit like a rowing crew deciding that each member of the eight can pull on an oar without taking any notice of the other seven," says Denis Noble, professor of cardiovascular physiology at Oxford University. His research group has discovered a mechanism that could explain why arrhythmia occurs during a heart attack (*Nature*, vol 328, p 634).

The two large chambers of the heart, the ventricles, contract from the base of the heart; this drives blood out of these chambers and into the arteries leading to the lungs and the rest of the body. A special group of cells, called the sino-atrial node, controls this rhythmic contraction. Certain hormones, called the catecholamines, speed up the overall rate of contraction.

Steve Connor

When we experience "fight or flight", or perhaps something more erotic, these hormones make our hearts beat faster.

For about a decade or so, physiologists have known that during a heart attack massive amounts of these hormones, which include noradrenalin, are released and have something to do with the development of arrhythmia. What they did not know was how such chemicals could bring about this abnormal event. They suspected that arrhythmia was the result of some sort of electrical disturbance, but they had little idea how this occurred.

In healthy heart tissue a large potential difference exists across the membrane of the cells. Various mechanisms, such as a sodium and a potassium pump, make sure that one side of the membrane is more positively charged than the other. This potential difference means that there is a tendency for ions to cross the membrane if certain channels open up, which happens when the muscle is excited.

When Noble and his colleagues subjected isolated heart cells to large quantities of the catecholamines they found evidence of a completely new mechanism for transporting sodium ions across the membrane and into the muscle cell. This movement of sodium into the cells causes such a massive disturbance of the potential difference across the membrane that the muscle cell is stimulated repetitively, meaning that it contracts without the need for an outside stimulus.

As this appears to be exactly what happens during ventricular arrhythmia, Noble and his colleagues suggest that they may well have found the mechanism that effectively kills people during a heart attack. Noble said: "This discovery explains why the heart muscle cells respond in such a way as to cause ventricular arrhythmia which can lead to total oxygen deprivation and immediate death. It also helps us to explain why certain drugs help to prevent heart attacks and this may enable future work to design even better treatment."

The next stage, Noble said, is to find out more about the new mechanism for transporting sodium ions across the cell. "We're half way there," he said, "there is a lot more work to be done." □

Castor oil shares its poison with dysentery bacterium

AS POISONS go, the protein extracted from the seeds of the castor oil plant—ricin—takes some beating. Just one molecule is sufficient to kill a cell (*New Scientist*, 16 July, p 59). Scientists have known for a long time that ricin acts by attacking ribosomes, which are part of the cell's essential machinery for synthesising proteins, but not what it does to the ribosome. Nor have they been able to explain why such a deadly protein could be useful to the plant itself. It certainly offers good protection, if a little zealous, against animals eating its seeds

Now, researchers from Yamanashi Medical College in Japan have found that ricin is a unique type of enzyme, which is similar to a toxin produced by a bacterium that causes dysentery.

Yaeta Endo and his colleagues report that ricin does not go inside a ribosome and randomly slice up the proteins or nucleic acids there (*Journal of Biological Chemistry*, vol 262, p 5908 and p 8128). Rather, the ricin lops off, precisely, an adenine residue from one position in the chain of nucleic acids that makes up a critical molecule within the ribosome, "28S" ribosomal RNA. In doing this, ricin leaves intact the sugar connections along the backbone of the rRNA.

Interestingly, the researchers found that ricin could not remove the specific adenine residue if the three-dimensional structure of the RNA molecule is disrupted. The deadly plant toxin needs to fit the target like a glove, and performed its trick only when the 28S rRNA was part of the whole ribosome, or was at least left in its normal shape. The area around adenine-4324 is the same throughout the animal kingdom, and it is not surprising that ricin is universally poisonous, except to bacteria that is, whose rRNA adopts a different shape around the target.

G. Cubitt/Bruce Coleman

The world's best protected plant

Endo and his colleagues also found that an agent of bacterial dysentery, *Shigella dysenteriae*, produces a toxin which also lops off adenine-4324. However, these Shiga-type toxins are not as deadly to animals, possibly because cells take them up less efficiently.

For a bacterium and a castor oil plant to share such a bizarre enzyme (one which removes only one particular nucleic acid base from one particular molecule) is puzzling. Sjur Olsnes, an expert on ricin working at the Norwegian Radium Hospital in Oslo, has suggested that *Shigella* and its allies have hijacked the ricin gene for their own uses, as their toxins have a similar sequence to ricin (*Nature*, vol 328, p 474). □

Tarsiers must stave off scurvy

TARSIERS—small, large-eyed primates that leap about at night in tropical rainforests in Southeast Asia—cannot synthesise ascorbic acid (vitamin C). In this respect, say J. I. Pollock and R. J. Mullin, of Duke University in North Carolina, tarsiers differ from lorises, lemurs and other members of the prosimian suborder of primates with which they are usually classified (*American Journal of Physical Anthropology*, vol 73, p 65). It allies them instead with the anthropoids—monkeys, apes and humans.

Vitamin C is essential for growth and tarsiers, like humans and some other animals, must have ascorbic acid supplied in their diet. We get it from leafy vegetables and fruits; tarsiers apparently stave off scurvy by having a crunchy diet of ants, beetles and other insects.

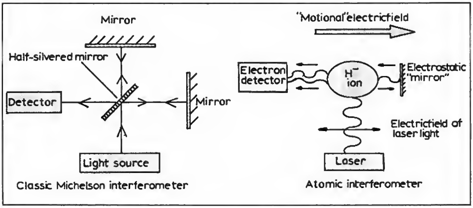
According to Pollock and Mullin, tarsiers lack the enzyme L-gulonolactone oxidase, which catalyses the final step in the synthesis of ascorbic acid from glucose. All anthropoids lack this enzyme.

Anthropoids are not exceptional in being unable to manufacture ascorbic acid. For example, guinea pigs and bats also need to eat food containing the vitamin. But most vertebrates have the right enzyme and can synthesise their own ascorbic acid. Pollock and Mullin comment that there seems to be no close relationship between diet and the possession of the enzyme. Why some animals have lost L-gulonolactone is somewhat puzzling. □

Reflections on a speedy electron

SCIENTISTS in New Mexico have created an "atomic interferometer". Their experiment behaves like an analogue of the classic Michelson interferometer, used to measure the velocity of light relative to a supposed "ether" in 1887. But in this case, the interferometer itself is moving close to the speed of light.

Howard Bryant, from the University of Albuquerque, has for some years led a research programme at the Los Alamos National Laboratory, studying the negative hydrogen ion, H^-. This is the next simplest atomic system to the hydrogen atom itself. It consists of a hydrogen nucleus (a single proton) with not one, but two electrons.



In the atomic interferometer, the H^- ion sees a high electric field due to its motion through a magnetic field. A laser stimulates the emission of an electron from the H^- ion. Provided the laser beam is polarised with its electric field vibrating as shown, the electron has a probability to go left or right. This probability is described by a wave function travelling in both directions

In these experiments, Bryant and his colleagues have been studying the process of "photodetachment". A photon induces the H^- to emit one of its electrons, so that it returns to the normal, neutral hydrogen atom (H^0) state. The photons are supplied in a laser beam, while the hydrogen ions are in a beam produced by the linear accelerator at the Clinton P. Anderson Meson Facility at Los Alamos.

In the interferometer experiment, the researchers applied a small magnetic field in the region where the laser beam and the H^- beam cross (*Physical Review Letters*, vol 58, p 2412). Because the H^- ions are moving in their own reference frame, they "see" the magnetic field as an electric field acting at right angles to both the magnetic field and the direction of motion. (This is a well known effect in electromagnetism.) The size of this electric field is directly related to the size of the magnetic field and to the velocity of the particles. The H^- ions are moving at nearly 85 per cent the speed of light, so the electric field appears large, in the region of 0·5 megavolts per centimetre for a modest magnetic field of 0·1 tesla.

The effect of this "motional" electric field is to accelerate, or decelerate, the "photodetached" electrons. An electron emitted towards the positive potential is accelerated, while one emitted in the opposite direction, towards the negative potential, is slowed down. This electron is eventually stopped and its motion reversed—just as a ball thrown up into the air comes back down. Moreover, by the time this electron returns to the position of the atom, it is travelling once more with the speed at which it was emitted—again like the ball thrown in the air. This means that the reversed electron is now like an electron initially emitted in the opposite direction (towards the positive potential), but delayed in time.

According to quantum theory, a "wave function" describes the electron involved in the photodetachment process. This wave function must cover all directions possible for the electron's emission. However, at the position of the atom, the "delayed" portion that describes what happens if an electron is slowed down and reversed can overlap with the portion describing an electron emitted in the opposite direction. And these two portions of wave can interfere. If they add together constructively, then an electron is emitted leaving a hydrogen atom behind; if the interfering waves cancel, no electron emerges.

The reversed portion of electron wave behaves just as if reflected by a mirror, rather as light is reflected in the classic optical interferometer (see diagram). Provided the distance to this "mirror" is not too great, interference effects will occur at the atom between the portions of electron wave. Whether the portions add or cancel depends on the distance to the mirror, and this in turn depends on the energy of the electron. The more energetic the electron, the farther it can travel against the motional electric field before being slowed down enough to be stopped and reversed in its motion.

Bryant and his colleagues count the hydrogen atoms produced. As they increase the energy of the laser photons, the number of hydrogen atoms increases steadily. But superimposed in this steady rise is a regular ripple. This ripple is the effect of the interfering portions of electron wave alternately adding and cancelling as the "mirror" is moved. But the interference effect is something that occurs in the reference frame of the H^- ions, which are themselves moving close to the speed of light. Whether such a fast moving interferometer can provide any new tests for the theory of special relativity remains to be seen. **Christine Sutton**

Breast is best to begin with

THE advantages to a baby of breast-feeding are becoming part of middle-class folklore. And there lies the rub. It is often difficult to disentangle whether the breast-fed baby's superior development is the result of breast-feeding itself or of the generally higher socioeconomic status and physical wellbeing of its mother. In a new study, Janet DiPietro at the University of Maryland found that differences between breast and bottle-fed infants emerge at an early age. The speed at which differences appear indicates the advantages of breast-feeding (*Developmental Psychology*, vol 23, p 467).

DiPietro studied two groups of babies that had undergone similar births and were physically alike in all respects except that breast-fed babies were a little heavier at birth. After correcting for this, the American researchers found that, at 1 to 2 days old, sleeping breast-fed babies had a slower but slightly more variable heart beat, and superior nervous control of the heart. The differences indicate greater physiological wellbeing. Perhaps surprisingly, the breast-fed babies were more irritable, less consolable and less proficient at tests of orientation. The scientists wonder whether colostrum, secreted in the first few days after birth, contains some activating agent to keep the baby alert, and so enhance the process of bonding between mother and infant. ☐

Giant arcs echo ancient quasars

GIANT circular arcs, bigger than any known galaxy, have been discovered in distant clusters of galaxies. According to J. I. Katz, of Washington University, St Louis, Missouri, these perfectly circular features may have been produced by light from a now defunct quasar, scattering from a sheet of tenuous material in intergalactic space.

Such arcs are known as "light echoes", and were first observed on a smaller astronomical scale in 1901 after the explosion of Nova Persei. A similar effect produces haloes around street lights on a wet night. But in order to explain the giant arcs in this way, Katz has to invoke the existence of a flat sheet of scattering material more than 100 kiloparsecs (325 light years) across. He suggests that this may be an extended disc centred on a supergalaxy too faint to be seen in its own right because it is so spread out (*Astronomy and Astrophysics*, vol 128, p L19). If so, the supergalaxy may dominate the cluster in which the giant arc is seen, with other galaxies relegated to the role of satellites, rather in the way that globular clusters of stars orbit our own Milky Way. ☐

Halley's polymer

FOR several decades, astronomers have been finding ever more complex molecules in the depths of space. Now an international team of researchers has found evidence for a polymer, a large molecule in which a basic unit repeats. The polymer, polyoxymethylene, exists in Halley's Comet and is a linear chain of polymerised formaldehyde (*Science*, vol 237, p 626 and 628).

The evidence comes from an instrument called the Positive Ion Cluster Composition Analyser (PICCA) which flew on board Europe's Giotto spacecraft. Giotto flew within 600 kilometres of the icy nucleus of Halley's Comet in March 1986.

PICCA measured the mass composition of the gases surrounding Halley's Comet up to a mass of 210 atomic mass units (amus). The instrument found peaks at 61, 75, 91 and 105 amus. The systematic nature of this spectrum, with peaks separated at roughly 15 amus, suggests the presence of a repeating molecule, rich in carbon, hydrogen and oxygen, which sunlight can break up into small pieces. Until now all the molecules observed around comets have been such fragments and their parent molecules a mystery. Polyoxymethylene would fit the bill. ☐

Resistant strains of malaria: one way to beat them

MALARIA is on the increase. The latest figures from the World Health Organisation suggest that there are about 100 million cases a year, one to two million of them fatal. Most cases are in tropical parts of Africa, Asia and South America, where the *Anopheles* mosquito that transmits the parasite is common. International travellers are also at risk. This year more than 2000 British tourists are likely to contract malaria.

One of the reasons for the steady increase in malaria has been the spread of resistance to chloroquine, one of the best and cheapest antimalarial drugs. David Payne of the WHO Malaria Action Programme has traced the spread of chloroquine resistance around the world (*Parasitology Today*, vol 3, p 241). Resistance began independently in two places, South East Asia and Latin America, but then spread to cover much of the northern part of South America around the Amazon Basin, and most of the Malaysian peninsula, Cambodia, Thailand and Vietnam.

In the 1970s, while resistance spread out from these two centres, it also cropped up in an entirely new place—East Africa. Resistant strains of falciparum malaria have since infiltrated South East Asia and many of the Pacific islands, into China, Pakistan, Afghanistan and Iran. There are resistant strains in most of Central, East and Southern Africa, and suspected resistance in West Africa.

Payne stresses that despite resistance, chloroquine remains the best drug for treating people on a large scale because it is cheap and has few side effects. Chloroquine is a 4-aminoquinolone. It works by killing the asexual stages of the parasite, the sporozoites that circulate in the blood stream. Usually, chloroquine eliminates sporozoites within two to three days. Taken as a precautionary measure, it will prevent infection by nonresistant strains of the parasite. Although scientists are still not sure how the drug kills the parasite, it probably alters the permeability of the protozoan's cell membrane so that it cannot absorb essential nutrients from the breakdown of haemoglobin in the host's blood.

No one knows how the parasite develops resistance to the drug, but in the same issue of *Parasitology Today*, Jeremiah Ryall, of the Walter Reed Army Institute, Washington, discusses a possible way to reverse resistance by giving a calcium ion antagonist at the same time as chloroquine. Calcium antagonists, such as verapamil, prevent calcium ions from crossing cell membranes. In *in vitro* studies, Ryall found that verapamil allows normal doses of chloroquine to kill resistant strains of malaria.

Verapamil is often given to treat heart arrythmias and, like many other calcium antagonists, it is known to reverse drug resistance in certain cancer cells. As several researchers have pointed out, malarial parasites share many characteristics with cancer cells, including an ability to multiply very quickly. Both types of cells make heavy demands on their hosts for nutrients. Inhibition of the cell's metabolism may be the best way to control them. ☐

Sunscreens block vitamin supply

TOO MUCH SUN is bad for the skin: with recent warnings of the risks of skin cancer, sun worshippers are slapping on the barrier cream with renewed relish this summer. However, scientists at the University of Illinois warn that overuse of sunbarriers could damage your health (*Journal of Clinical and Endocrinological Metabolism*, vol 64, p 1165).

Vitamin D is unique in that the body can make it only in the presence of sunlight. The precusor of the vitamin is a steroid, 7-dehydroxcholesterol, which is secreted onto the skin and then converted to previtamin D by a photochemical reaction involving ultraviolet-B radiation. Conversion to vitamin D is spontaneous and the skin then absorbs the finished product into the blood. People also take in a supply of ready-made vitamin D from certain foods; this is an important source of the vitamin, particularly for young people. With today's high standards of nutrition, vitamin deficiency through lack of exposure to sunlight is rare.

Too much concern about skin protection, however, particularly among older people, could swing the pendulum back the other way, say Michael Holick and his colleagues. Barrier creams absorb UV-B radiation of the wavelengths required for synthesis of vitamin D. Holick applied the active ingredient of sunscreens, para-amino benzoic acid, over the entire body of volunteers. He found that within a day or two of exposure to sunlight, the levels of vitamin D in their blood had fallen. When he applied the chemical to isolated patches of skin, irradiated with ultraviolet light, it substantially reduced the amount of previtamin D in the skin.

Holick believes that elderly people especially should be warned of the dangers of extensive use of sunscreens, because they rely on exposure to sunlight for almost their entire source of vitamin D. ☐

Joanne O'Brien/Format

Covering up carries risks for the elderly

Hot neutrinos may yet dominate the Universe

NEUTRINOS seem to be the flavour of the month in physics. Hot on the heels of estimates of their mass based on observations of the recent supernova (*New Scientist*, 25 June, p 34) comes a paper in *Physical Review D* (vol 35, p 2832), suggesting that scientists may have been too eager to dismiss the possibility that neutrinos may dominate the Universe gravitationally.

Two theorists, working at Virginia Polytechnic Institute and State University, Blacksburg, Virginia, have been investigating the implications of the fashionable superstring theory for neutrino masses. This is the theory that starts from the assumption that the fundamental "particles" are tiny one-dimensional objects—"strings". The calculations show that within the framework of this theory one flavour of neutrino, the kind associated with the electron, "ought" to have a nonzero mass, with a value less than 10 eV (the mass of an electron is 500 000 eV).

This could make life interesting for cosmologists. A few years ago, astronomers were eager to invoke clouds of neutrinos with just that mass as the dominant gravitational feature of the Universe, hoping thereby to explain how galaxies form. That idea has lately been overturned by the "cold dark matter" model, which describes the evolution of the Universe in terms of dominant particles of some unknown and as yet undetected form. Some researchers, however, have continued to try to work with the neutrino model, on the not unreasonable grounds that we do at least know that neutrinos exist. In a recent issue of the *Astrophysical Journal* (vol 317, p 26) Ramanathan Cowsik and P. Ghosh, of the Tata Institute, Bombay, revive the model.

To some extent, this proves the old adage that in astronomy any competent theorist can reconcile any model with any set of observations. But the mass of the neutrinos required by the Indian team is about 10 eV, fitting in neatly with the supernova observations and the superstring calculations, and certainly not in conflict with the accelerator experiments. Moreover, Cowsik and Ghosh claim that the neutrino model ensures that as galaxies form their rotation rate is matched to their overall mass, and therefore their brightness, in just the way discovered by Vera Rubin and her colleagues at the Carnegie Institution of Washington (*New Scientist*, 2 July, p 34). The ball, it seems, is back in the court of the cold, dark matter theorists. ☐

How cells get the message

Nancy Heneson, Washington DC

THE IDEA of cells as social creatures, engaged in constant communication with their environment and with one another, is not new. In the late 1960s and early 1970s, Earl Sutherland laid out the basic steps involved in cells' responses to hormones, describing a signal discriminator (receptor), which activates a catalytic subunit inside the cell, which in turn activates 3′-5′-cyclic adenosine-5′-monophosphate (cyclic AMP), which through several more metabolic steps results in activation of functional proteins.

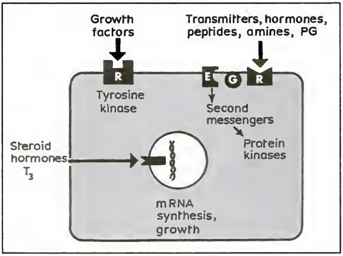
However, in the past few years, the techniques of molecular biology, particularly recombinant DNA technology, have enabled cell biologists to probe the communications apparatus of the cell in much greater detail. What they have found proves that the metaphor of the cell as "newsgatherer and interpreter" holds up very well, right down to the most fundamental level.

At a seminar at the National Institutes of Health in Washington, DC*, Allen Spiegel, Michael Gottesman and Robert Adelstein reviewed the mechanics of signal transduction in cells and discussed the latest advances in understanding how cells get the news. The "news" is signals, so-called first messengers, that originate outside the cell. These include many types of substances—hormones, amines, peptides, and glucose and other nutrients—as well as energy, such as photons.

The first task in newsgathering is to allow the news to be received. The cell membrane is the port of entry for news from the outside world. Signals from the environment cross the cell membrane in one of three ways (see figure).

Some signals pass directly through. Steroids, such as cortisol, aldosterone, and the sex hormones, as well as thyroid hormones, readily penetrate the fatty membrane because they are soluble in fat. Such substances have a powerful, but delayed, action because the receptors to which they bind are not on the surface of the cell, but are near or in the nucleus. Research on steroid hormones suggests that the receptors for these chemicals actually bind DNA, resulting in transcription of specific bits of DNA into messenger RNA and, ultimately, the production of new proteins. This makes sense if one thinks about the events associated with influxes of steroid hormones into the cell, such as puberty. The hormone reaches its receptor somewhere near or in the nucleus of the cell; the activated receptor binds DNA, thus turning on the process of protein synthesis, and, ultimately, secondary sexual characteristics appear.

Another group of signals, known by the rather vague term "growth factors" (which basically means any substance that causes cell division), make their first stop inside the cell membrane, where their receptors are located. These receptors, called tyrosine kinases, are proteins that also function as enzymes. The growth factors, as well as the hormone insulin, work by "telling" the enzyme component of the receptor to attach phosphate groups to the amino acid tyrosine in certain key proteins.



Three ways a signal can cross the cell membrane

Not all receptors embedded in the cell membrane are enzymatic. In these cases, a third mode of communication between signals and the cell exists, involving two messengers, instead of one, to initiate a reaction. Many hormones, peptides, amines, and chemotactic factors, as well as photons and odorants, use this system. In brief, the system works like this: the signal binds to a receptor embedded in the cell membrane. The receptor lacks direct enzymatic activity; instead, a group of proteins known as G-proteins (for guanine nucleotide binding proteins) act as "couplers", attaching the receptor to various "effector" proteins. This coupling activates a second messenger, often cyclic AMP, which in turn activates the protein kinases. Thus, this third system adds a step—the coupling by G-proteins of the receptor and the effector—to the process of signal-receive-activate-deactivate.

As a vital communications link, the G-proteins play an important role in the economy of normal cellular processes. For example, in the highly complex process of vision, one signal (light) reaching one type of receptor (rhodopsin) can recruit many G-proteins, causing a cascade of activation in as many as 10 000 cells. Similarly, some G-proteins stimulate cyclic AMP and other second messengers; others inhibit them; thus, the same family of proteins acts as both up- and down-regulators of a given process.

Conversely, malfunction of or interference with G-proteins causes several known types of disease. Cholera and whooping cough are both disorders of information processing involving the G-proteins. In the case of cholera, the "news" keeps on coming because the enzyme that normally allows the G-protein to stop activating the effector molecules is missing. As a result, the excess cyclic AMP in the gut causes the lethal diarrhoea. The pertussis toxin, by contrast, stops any news being transmitted within the cell by interfering with communication between the G-protein and the receptor, thus preventing coupling with an effector molecule. The resulting insufficiency of cyclic AMP causes hypoglycaemia. Some hormonal deficiencies can also be traced to the failure of G-proteins to couple with effector proteins. These deficiencies result from resistance of the cell to the action of hormones rather than from lack of the hormone. Pseudohypoparathyroidism, a syndrome characterised by stoutness, short stature, mild mental retardation, and no sense of smell, was originally thought to be caused by a defect in the receptor for parathyroid hormone. However, it is now known that this, and possibly other heritable diseases of hormone resistance, are caused by a deficiency of functional G-protein.

Perhaps the most intriguing—and promising—aspect of how cells get the news is the insight it has provided into cancer. It is fairly well accepted that many, if not all cancers, are initiated by oncogenes, which, when turned on, disrupt the orderly growth of cells. The oncogene alters the DNA blueprint, cutting the cell off from normal communications and allowing it to grow wildly. Scientists are beginning to match the protein products of various oncogenes to the proteins involved in normal signal transduction. Molecular analysis of the Rous avian sarcoma virus, which carries the *ras* oncogene, reveals that this gene is very similar to the G-proteins. Similarly, other oncogenes have been found to be structurally analogous to certain growth factors, and receptors for growth factors.

Thus, the theory goes, cancer results when the protein product of an oncogene mimics a normal protein involved in the chain of intracellular communication, causing either the wrong kind or too much news to be assimilated. For example, the oncogene *erb* b is an altered form of the receptor for epidermal growth factor. Unlike the normal receptor, it lacks regulatory sites that allow it to be turned off. A vicious cycle establishes itself: the cell keeps making growth factor, which causes it to grow. The more it grows, the more growth factor it makes, and so becomes a cancer. This view of cancer opens a new field for possible therapies. Substances that inhibit the key enzyme tyrosine kinase, for example, could stop a cancer at its source—a vast improvement over the current approach of blasting cancerous and normal cells alike with highly toxic drugs. However, such a treatment is probably years away. At present, drug companies are more interested in the structure of the G-protein and ways to design drugs that will communicate directly with that protein rather than just clumsily block a particular receptor. ☐

***How Cells Get the News, National Institutes of Health, 24 June 1987.**

TECHNOLOGY

How to rid the Gulf of mines

Steve Connor

THE FOUR minehunting boats that Britain has sent to clear the Gulf are among the most sophisticated of their kind in the world. The hulls of the four Hunt class vessels are made of glass-reinforced plastics. Their low magnetic signature makes them less likely to detonate mines triggered by the magnetic field of a metallic ship.

The vessels can drag large coils of copper wire behind them, which, when an electric current flows in the coil, can mimic the magnetic field created by a conventional metallic ship. This should explode those mines with magnetic influence triggers. They also have equipment to imitate the noise of a ship's engine and propellers. This should deal with mines detonated by sound waves.

The boats, Brocklesby, Bicester, Hurworth and Brecon, are 57 metres long, which makes them smaller than the average vessel in the Royal Navy, but still the largest minehunters in the world with plastic hulls. The Ministry of Defence says that it has only recently perfected the difficult task of making hulls of such a size from glass-reinforced plastics.

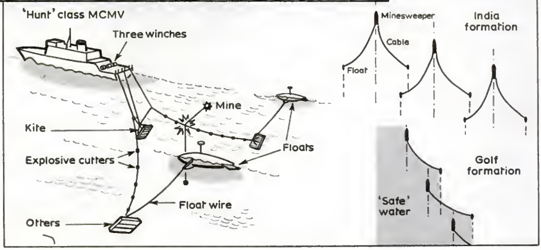
The boats, called mine counter-measure vessels (MCMVS), have as few metallic objects on board as possible, and most of that metal is demagnetised. Any that has to be magnetic is surrounded by tiny magnets arranged in such a way as to reduce the magnetic field.

The four boats will sweep for mines with equipment towed behind them: lengths of cable, up to 400 metres long, suspended by floats on either side of the vessel. The cable is slightly serrated so that it will gently cut any cables that anchor mines floating just below the surface.

The minesweeping cables of the Hunt class boats have explosive cutters every few metres. The cables gradually drag mines towards the cutters. When a cutter reaches a mine, it explodes to either detonate the mine, or release it from its anchorage so that it floats to the surface.

The boats also tow structures attached to the minesweeping cables, called "kites" and "otters", to ensure that the cables splay out at some distance from the path of the vessel (see diagram). By altering the length of the cables connecting the floats to the otters, the boats can sweep at varying depths.

AP



The Hunt class vessels are the largest minehunters with hulls made of glass-reinforced plastics. The four boats will sweep the Gulf in Golf formation for safety

Frogmen can easily defuse or detonate mines floating on the surface of the sea. It is also possible to explode a floating mine by firing bullets at it, but naval commanders say that this runs the risk of sinking the mine without detonating it.

The Ministry of Defence says that the four vessels will sweep for mines in "golf formation". The boats use only one side to sweep for mines, which the navy describes as "single oropesa". (The Oropesa was the first boat to sweep for mines during the First World War.) This means that only the ship leading the formation is entering water that has not been swept for mines. This is slower than "India formation", when both sides of the vessels sweep for mines in "double oropesa" (see diagram). All the boats sailing in India formation sail into water that has not yet been swept of mines.

The navy intends to send either a helicopter or a small craft in front of the boat leading the formation to search visually for mines. In the clear waters of the Gulf, it is relatively easy to spot mines floating several metres below the water. But, as a senior naval commander says, "this business is not without its risks".

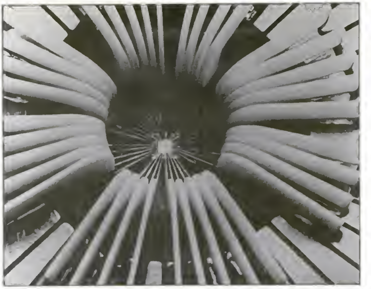
In addition to sweeping for mines, the Hunt class boats can also hunt them with sonar equipment underneath the boats. When the sonar spots a mine lying on the seabed, a robot submersible can then go down to try to find it. When the sonar images of the robot and the mine coincide, which means that one is practically on top of the other, then sailors on board the boat can locate the mine exactly with the help of a camera on the robot.

The robot can then leave an explosive device behind to destroy the mine. Alternatively, divers can go down and try to defuse the mine and bring it back. The Ministry of Defence is keen to bring souvenirs back to Britain to discover where the mines come from which the Royal Navy did during the Falklands War.

The mines found in the Gulf are of the traditional type, with spikes protruding from the mine's casing. These mines are detonated by bending one of the spikes. This breaks a glass phial containing acid, which runs into a primitive battery, producing a current that detonates the bomb. These mines can contain up to half a tonne of high explosives, enough to tear holes in the thickest hulls.

It is possible to anchor mines to the seabed, with delay mechanisms that can release the mine to shallower depths after a certain period of time. These devices would make it more difficult to clear an area of mines. There is no evidence, however, that even these relatively unsophisticated mines are present in the shipping lanes to and from Kuwait. □

Memory chips take on finer dimensions



Test wires from a chip with the world's smallest transistors

AN AMERICAN company claims to be well on the way to producing a transistor with components one-tenth of a micron across. According to computer maker IBM, transistors of this size could be used to build memory chips capable of storing one billion bits—a gigabit—of data.

The present one megabit memory chips are made from lines one micron wide. The next generation of memory chips, 16 megabit chips, will have dimensions of half-a-micron. At present the parts in IBM's experimental transistor vary between a quarter and one-tenth of a micron (a thousandth of a millimetre), but IBM maintains it is ahead of its rivals in the miniaturisation game. The company's scientists are up against what is known as scaling theory, which predicts the points at which parts get so small that they will not work any more. For instance, at a tenth of a micron, the voltages needed to switch a transistor would also damage them.

At low temperatures, smaller voltages are needed to switch a transistor. IBM has had to cool its devices in liquid nitrogen to get them to work. Fabricating transistors of sizes around one-tenth of a micron is not easy either. IBM has had to develop its own electron beam machines to inscribe the small and complex patterns on silicon.

Next month, IBM scientists will be publishing a paper in IEEE Electron Device Letters which outlines experiments to measure the power of their small transistors. The paper reveals that IBM has produced field-effect transistors which put out the strongest electronic signal ever recorded from a transistor.

The laboratory transistors are n-channel metal oxide silicon (NMOS) transistors. IBM plans to apply its shrinking techniques to complementary-channel (CMOS) chips which work in a different way from the NMOS chips, but are faster at switching. IBM acknowledges it will have to improve the techniques used to transfer chip designs to silicon still further if it is to produce what is called a fully scaled chip (one in which all elements measure a tenth of a micron or less across). ☐

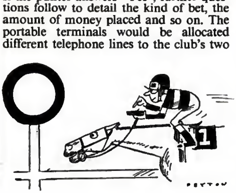
Hong Kong bets on gambling technology

THE ROYAL Hong Kong Jockey Club is developing a hand-betting terminal that will allow punters to place bets from anywhere in the territory simply by plugging the terminal into a telephone line.

The gadget, the first of its kind in the world, is to be tested next April among 200 customers that currently have telephone (telebet) accounts with the club. Its design is a joint effort between the club's own computer engineers and the Hong Kong company called Baritronix. David Yau, the Jockey Club's Information Secretary, said the terminal was being developed to ease congestion at the telephone exchange currently handling telephone betting.

The club presently has 365 000 telebet accounts. "They don't all phone in at the same time, but even if 10 000 people were to call 10 minutes before a race the exchange would be congested," Yau says.

The device will be about three times the size of an ordinary pocket calculator and will work rather like a computerised bank teller. Once the punter has keyed in an identification tag it would ask: "Place bet?" If the punter answers "Yes", further questions follow to detail the kind of bet, the amount of money placed and so on. The portable terminals would be allocated different telephone lines to the club's two central computers, which would then process the information they received, placing bets and debiting money from the relevant accounts.



The system would bypass the telephone exchange that currently feeds the calls through to 1600 operators employed by the club to enter the punters' information into the central computers. The prototype device will display English script but the ultimate aim is for the device to use both English and Cantonese.

Racing is the only form of gambling permitted in Hong Kong and bookmaking is illegal. The Jockey Club enjoys a monopoly on betting in the territory. The club is non-profit making. What is not spent on operating costs, reinvestment in the club, government duties and prize money is given back to the community. ☐

Televisions get flatter and slimmer

FANS of flat screen television are again forecasting the demise of the cathode ray tube. The latest contender is a Finnish-developed television with a screen that is 2 centimetres deep, designed to hang on the wall like a picture. The manufacturer claims that "the days of the bulky television set are numbered".

This may be a little premature. The screen is black and white only, and at 18 centimetres across the diagonal is much smaller than the screens to which today's viewers are accustomed.

Perhaps more important than its slimness is that the new TV combines flat-screen technology with the ability to conform to signal-processing standards for television anywhere in the world. Goran Wahlberg, research director for its manufacturers, Finlux, claims that it can be programmed to process the signal according to how it is coded. This is necessary because different countries have different codes by which the signal goes from the television camera to the receiver.

The Finlux television, he says, can cope with European, Japanese and American standards. It will also be able to cope with high-definition television standards of the future.

The picture is produced by means of an electroluminescent membrane on which is laid a grid of current-carrying wires. At each point where vertical and horizontal wires cross, the material glows, forming the pixels that make up the picture.

The problem with electroluminescence is developing a colour screen. Past attempts have failed because to generate full colour requires a cluster of 3 "picture points"—one made from a material that can emit red light, one that emits green and one blue. Because it is difficult to find materials that glow with the same intensity, the resulting coloured picture can look unbalanced and unnatural.

Although Wahlberg says that his company hopes to be selling colour televisions that deal with different signal codes by 1993, he admits that the company is looking at other flat-screen technologies as well as electroluminescence.

The colour screens under development at Finlux will have a diameter of 36 centimetres. One approach, he says, is to use liquid crystal displays. The Japanese have been working on flat screens using LCDs for some time. They have found, however, that they are difficult to view in some lights. ☐

New shuttle joints look a safe bet

A REDESIGNED joint to replace the type that failed when the shuttle Challenger crashed last year proved its reliability in full-scale tests earlier this month.

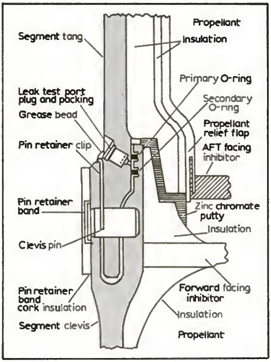
The joint divides two segments of the shuttle's solid-rocket boosters. The O-rings and putty (see diagram) that provides a seal for the joint failed during Challenger's launch, and hot gases escaped from the booster. Morton Thiokol, the company that makes the boosters, has redesigned another of the joints. It did not fail, but showed signs of stress. NASA's Marshall Space Flight Center ran the first tests on this joint last week.

The joint that failed is known as a field joint, because the sections of the booster are assembled at the launch pad rather than in the factory. To improve the joint's strength, Morton Thiokol put an extra lip on the central part of the joint to clamp the two metal parts together more tightly. The engineers added another O-ring and replaced the putty with a J-shaped seal.

The new seal is important because it is shaped so that, as engineers assemble the segments, air is forced out slowly from between the joint. The old system, with putty, pushed the air out in bursts. This created holes in the insulation between the propellant and the joint, through which gases could escape.

NASA's tests earlier this month were of the full-sized joint in a short stack of segments. Later this year, NASA will test the joint in a complete solid-rocket booster fired horizontally. Some engineers believe that the rocket should be fired vertically, as it is during a launch. Bob Marshall, the space transportation programme manager at Marshall, says: "The stresses on the rocket lying horizontally are as great as those when the rocket is vertical."

NASA ran two tests on the field joints firstly with a small amount shaved off the primary O-ring, and secondly with a flaw in the J-seal. Marshall says that the test engineers left the ignitor running for between half- and three-quarters of a second, which gave the same initial pressure build-up as would occur during a launch. Within the next few weeks engineers will run the ignitor for the time it would run in a launch. Marshall says: "If anything, the joints performed better than we anticipated."



The joint that led to disaster

The second joint that Morton Thiokol has redesigned divides the nozzle from the case of the solid-rocket booster. The old joint has about 100 bolts parallel with the long axis of the booster; the new joint is strengthened, with extra bolts fixed perpendicular to the booster's axis.

NASA expects the shuttle Discovery to fly in June 1988. At the end of July, NASA's engineers at Kennedy Space Center tested the electrical systems of Discovery. Before the launch, Marshall will run tests qualifying the boosters for flight, one with a hot case and one with a cold case. The hot-firing comes first, because the launch will be in the summer. ☐

Pacer cures heart flutters

DOCTORS in Canada have fitted a patient with a novel heart pacer. It monitors and regulates his heartbeat, but can also shock his heart back to a normal rhythm when it begins to flutter. The doctors can programme the levels of power required.

The pacemaker cardioverter defibrillator (PCD) took five years to develop. It is about two to three times the size of a normal pacemaker, because it needs a larger battery. The unit is about the same size as a powder compact.

Unlike a standard device, it is not fitted in the chest cavity, but in the upper left of the abdomen.

Orthodox pacemakers deliver shocks to the heart of about 30 joules. The PCD can deliver any level up to 30 joules. The patient's doctor determines the level of shock required. Connected to the heart is one pacing electrode for monitoring and regulation. Three patch electrodes deliver the required shock from a pulse generator in the pacer.

The team that developed the pacer was drawn from specialists at University Hospital in London, Ontario, and from a company called Medtronic. The researchers say that if a monthly shock is needed, the battery will have to be replaced every year. The pacer could work for over a decade with one battery if the patient needed only one shock each year. The PCD is expensive—it costs about 3 or 4 times as much as a normal pacemaker. ☐

Keeping cool in space

ELECTRONIC equipment heats up as it operates, even in the cold of space. Many electronic devices must be kept cold in order to work properly, but the bulky compressors needed by standard refrigeration are a nuisance in space. Two companies in the US—Hughes Aircraft and the Astronautics Corporation—have developed a better fridge for use in orbit.

It uses a ring made of gallium and gadolinium, placed between the poles of an electromagnet. the alloy heats and cools according to where it is in the magnetic field. When it is demagnetised, it cools, and transmits its heat to the magnet. The heat is carried away by a cooling fluid.

A second heat-carrying fluid flows over the cold end of the ring, and is used to chill the required equipment. The coolant can be chilled to −253°C, the temperature of liquid hydrogen, much more efficiently than with standard refrigeration, according to Hughes.

Among the equipment most in need of cooling are detectors of infrared radiation, which could be used for communications between orbiting stations, and processors for handling large amounts of data. Both technologies are essential to Strategic Defense Initiative, or "star wars", which gave Hughes $5 million (about £8m) to develop the fridge. ☐

Clearer voices from the deep

DEEP-SEA divers have trouble communicating underwater, not because they can't speak, but because when they do, they sound like Donald Duck. Divers cannot breathe ordinary air during deep dives. The high pressure would force too much nitrogen and oxygen into their blood, damaging tissue and casuing the inebriated behaviour called nitrogen narcosis. Divers therefore breath artificial mixtures of oxygen, a little nitrogen, and helium.

Sound travels faster in such gas mixtures than it does in air. A column of the gases in a human throat therefore vibrates differently from a column of air, and causes a different sound to come out. The frequency of the fundamental tone of a speaker's voice is not altered, but the formants, or the resonant frequencies superimposed on the fundamental tone, are shifted towards higher frequencies.

The formants are what give the voice its tonal "colour". The tone that emerges from a diver's throat sounds much like the distorted voice created for the cartoon character Donald Duck.

The West German company AEG has developed a transportable "speech distortion corrector", that can be worn by divers. The distorted frequencies that emerge from a given gas mixture correspond to specific frequencies that would have emerged in air. AEG's device analyses the frequencies in a diver's voice, then emits a sound in which the distorted frequencies are replaced by the normal ones. ☐

Puzzling moves on video chips

MULLARD, the British subsidiary of Philips has invested in the production of a chip set which improves the 8mm video system, even though Philips backs the rival VHS video system. Mullard announced the chips, saying that the 8mm system "has been accepted as a world standard". Philips in Eindhoven knew nothing of the Mullard announcement or innovation and says it "has no plans to sell 8mm video".

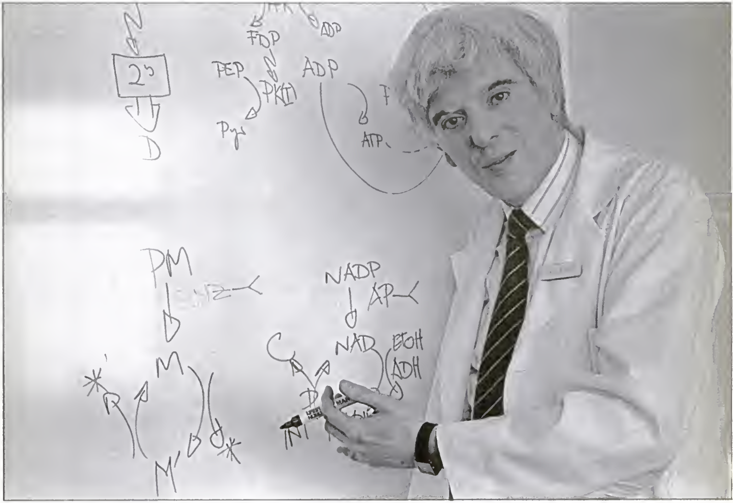
The new chip set puts high fidelity digital audio on video tape along with conventional picture signals. The 4 chips need only some RAM to form the complete audio section of an 8mm recorder. They consume only 60 milliwatts of power and are thus ideal for portable camcorders.

The system offers "after-record", which lets the video photographer read PCM digital audio from the tape, alter it and re-write it in exactly the same place, to allow for audio dubbing and editing. ☐

A licence on life

The business of making money out of genes is having a difficult birth. The biotechnology industry would like to make things easier by having patents on both genes and living organisms

Steve Connor



Jerry Mason

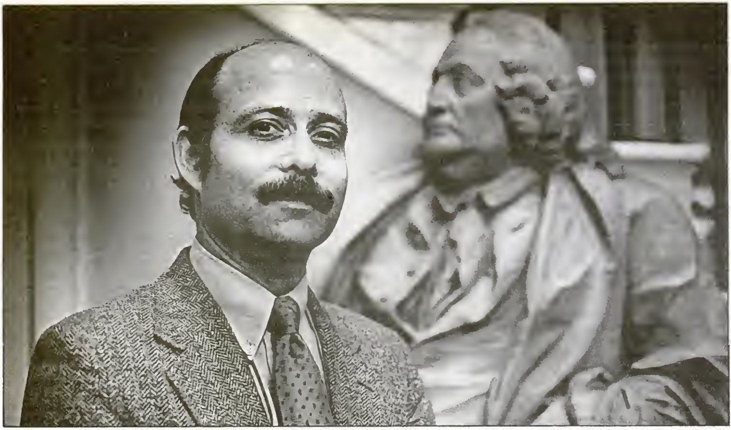
Colin Self: His private research led to an invention that proved to be worth millions of pounds, and more than 60 jobs

ON A SUNDAY morning in 1979, a young medical student went into his laboratory to do some extra-curricular research. He wanted to test a hunch he had that heat might be a simple way of isolating a certain enzyme from a bacterial soup. The university had turned the gas off, so he had to warm his broth of bacteria on a camping stove. The hunch proved right. Having isolated the enzyme, the young student went on to develop a technique that he later patented. The patent became the property of a new company, established to develop a suite of products based on the invention. In June of this year, a Danish firm, Novo Industri, bought that company for £8 million.

Colin Self, who is now a doctor at the Hammersmith Hospital in London, had little idea on that Sunday morning that he was on the road to success. Industrialists are now designing a plethora of diagnostic kits, such as pregnancy tests, based on his invention. The success of his patent is measured by the amount of money Novo paid for IQ Bio, the company that Self helped to establish seven years ago. As a result of those Sundays spent bent over a camping stove, more than 60 jobs now exist because Self patented his invention without mishap. Novo says that it will now create even more jobs at IQ Bio's laboratory in Cambridge.

Self's patent is the key to this success. Britain, however, does not have a happy record of patenting inventions in the field of biotechnology. Cambridge, in fact, was the location for what has become the most celebrated example of a missed opportunity for patenting a remarkable invention. Two scientists from the Medical Research Council's Laboratory of Molecular Biology, Georges Koehler and Cesar Milstein, developed a technique that, if properly patented, might have been worth millions of pounds in royalties. By fusing two types of cell, they cloned a group of cells that would produce identical antibodies, proteins that identify and attach to a given type of antigen—in this case the blood cells of sheep.

The blame for failing to patent "monoclonal antibodies" lies somewhere between Cambridge and the National Research Development Corporation in London. The NRDC then had the right of first refusal on inventions from public research centres in Britain. Self was fortunate because, as a medical student doing research in his spare time, he had the rights to his own work and could therefore patent the invention himself. He did this with the help of Hans Kornberg, the head of the biochemistry department at Cambridge, and Donald Braben, the head of the BP's Venture Research Unit. Kornberg introduced Self to Braben, who has, he says, money to give away, and the match proved perfect. The Venture Research Unit undertook to pay the cost of


Tony Sleep

In the US, companies can lay claim to patents on higher forms of life, something that Jeremy Rifkin and others find morally repugnant

patenting Self's invention internationally. "BP provided the fuel to keep the thing going," Self says. He had tried and failed to find funding from more conventional sources.

Like the work of Koehler and Milstein in the mid-1970s, Self's invention in 1979 came about with the help of work on antibodies. Self wanted to detect extremely minute quantities of a substance, a hormone for instance that indicates pregnancy. And he wanted to do this quickly, without having to use expensive equipment. It was possible to develop antibodies that could identify a substance, but how do you know that the antibody and antigen have bound together, so showing that the antigen is present?

One technique at that time was to coat a surface, the side of a glass slide for instance, with an antibody that would recognise the substance in question. This antigen would stick to the antibody, and stay on the surface, after washing. Scientists then add a second antibody that also recognises the antigen in question and so stick to the combination of first antibody and antigen. If this second antibody is labelled in some way, with a fluorescent marker say, then the sandwich of antibody-antigen-antibody still sticks to the fixed surface after washing, and the labelled antibody can be detected.

This simple technique is now the subject of a patent dispute between several biotechnology companies in the US. Hybritech, in San Diego, which is a subsidiary company of Eli Lilley, has sued two other companies, Abbott Laboratories and Monoclonal Antibodies, over Hybritech's rights to a patent on sandwich antibodies. Hybritech filed its patent in 1980. Other companies argue that the technique was an old one and all that Hybritech did was to apply it to monoclonal antibodies. The Patent and Trademark Office and the appeals courts in the US have so far ruled in favour of Hybritech, although this dispute is not yet over. Hybritech wants a permanent ban on the sale of products made by other companies that are designed on the process. At issue is a market worth several million dollars.

A variation on the process that Hybritech claims it owns is to attach an enzyme to the second antibody. This enzyme makes certain chemicals change colour, another way of visually recognising that the sandwich is sticking to the solid surface. There is a problem, however, with using a second antibody that is labelled in some way. If the substance that the scientist wants to detect exists in tiny amounts, then it can be a long time before the solution changes colour, too long perhaps to be of any use in a busy clinic or surgery. A test also becomes less accurate if it takes time because, for instance, the chemicals can degrade.

Self wanted to speed up the chemical reactions in order to detect minute quantities of antigen. His idea was to choose an enzyme for the second antibody that would turn an otherwise inactive chemical into one that then acted as an enzyme for a secondary chemical reaction. Self describes it as "a catalyst making a catalyst". The important step in Self's invention is that the secondary reaction does not consume the second "catalyst". All it takes is for a tiny amount of antigen to cause a tiny amount of the first catalyst to make a tiny amount of the second catalyst: this second catalyst then causes further chemical reactions, which changes the colour of the solution. The system is "exquisitely sensitive", Self says.

Biochemists now call the technique "enzyme amplification". When Self first described it to a young entrepreneur from the computer industry, Chris Curry, who then ran Acorn Computers, Curry remarked on the similarity with amplification in electronics. "My God," Curry told Self, "you've invented the transistor." Curry and his business partner, Hermann Hauser, had established IQ Bio just before meeting Self, and now their company had a *raison d'être*.

IQ Bio and its range of diagnostic products owe their existence to the patent of Self's technique of enzyme amplification. Larger companies are developing similar products for the biotechnology industry; they know the importance of proper patenting in this new market. William Duffey, the patent lawyer for Monsanto, an American chemicals company, describes just how important patents are to bio-technology: "Those companies in the private sector which are investing hundreds of millions of dollars in this new science do not accept the theory that patents are unimportant. Such a concept is particularly repugnant to patent-conscious, research-intensive pharmaceuticals firms dealing in global markets with drugs which require staggering investments of time and money before ultimately yielding a commercial return. To them the patent shelter is paramount. It is quite literally their sole incentive for risk taking."

Duffey says that the average cost of developing a new drug, including failures, is about £100 million. "Without the crucial period of patent protection there would be little chance for the pioneer to break even because the generic producers and the imitators would have marched in much earlier to capture the market share at his expense through price cutting."

What is a patent?

A PATENT must first of all be new. No other inventor must have filed a patent on the same invention, and nobody must have published the discovery before filing for a patent, although in the US there is a "grace period" of up to a year between publishing and filing a patent.

The next criterion for patenting is that an invention must involve a truly inventive step. Routine, trivial or unexpected modifications of an existing technology therefore do not count as fulfilling what patent attorneys call the "inventive step".

This is often the criterion that lawyers end up arguing about in the courts. The court then has to decide whether the invention is obvious "to someone skilled in the art". Biotechnology is such a new industry that patent lawyers often try to convince a court that something is inventive merely because the technology is so new and "unobvious". The recent court case in Britain between Genentech and Wellcome indicated that the court was not prepared to treat biotechnology any differently than to other technologies.

For a patent office to grant a patent, the invention must be industrially applicable. □

There seems to be an overwhelming case for patents in biotechnology, as in any other innovative field. But what exactly is a patent? Andrew Sheard, a patent lawyer specialising in biotechnology with Kilburn and Strode, a firm of patent attorneys in London, describes patents as a "bargain between an inventor, or those backing the invention, and the state. The deal is effectively this: if the innovator discloses his invention to the public in so clear and comprehensive a way that anyone can repeat his invention so as to get the benefit of it, then the state will, providing that the invention fulfils certain criteria, allow him a monopoly in the invention for a certain number of years—20 in most countries of the world."

The inventor must conform to certain criteria in order to patent an invention. The "invention" must be new, it must be truly inventive, and not just an obvious development of what is known already. The invention must be useful and the patent laws must not specifically exclude the invention in question. In the new science of molecular biology and genetic engineering, which did not exist 20 years ago, the same rules of patenting apply. Over the past 10 years, however, a number of disputes between inventors, and the patenting authorities have raised questions concerning the interpretation of the patenting rules.

The latest case occurred in July at the High Court of Justice in London. A British pharmaceuticals company, the Wellcome Foundation, questioned the patent on a genetically engineered protein awarded to Genentech, a biotechnology company in California. The protein, tissue plasminogen activator (t-PA), appears to be twice as effective as existing remedies for dissolving blood clots and so could become a very useful drug for people at risk of heart attack. The market for such a drug could run into $1 billion a year by the early 1990s. Genentech's patent gave the company the rights over all t-PA manufactured by splicing a t-PA gene into cells that could then be cultured to produce the protein in bulk. Wellcome also wanted to produce t-PA by a similar method and felt that Genentech's patent did not cover a technique that was truly novel and inventive. Wellcome therefore sued Genentech on the day the Patent Office in London granted Genentech the patent, 26 February 1986, and so the case went to the High Court.

Patent lawyers around the world watched the case of Wellcome versus Genentech carefully. They wanted to see whether the judge, Mr Justice Whitford, would treat the new techniques of biotechnology as inventive and novel purely because they are so new. In the event, Mr Justice Whitford took the view that Genentech's patent must be revoked. In his judgment, extending to 90 pages, he said: "As a claim to a product, t-PA produced by any known or hereafter discovered route in the field of recombinant-DNA technology, is too wide and is bad . . . It is a claim to an obviously desirable and potentially possible end reached by routes on which only limited guidance is given." The patent, he said, is too "broad".

This case dose not end here. Genentech said immediately after the judgment that it intends to pursue "vigorously" an appeal against Mr Justice Whitford's decision: "This patent decision relates solely to the UK," the company said, "We will continue to press our patent claims in the United States and in other jurisdictions" (*New Scientist*, 16 July 1987, p 25).

It is not unusual for patent cases such as this to drag on and on. The first patent on recombinant gene technology, based on a discovery of Stanley Cohen of Stanford University and Herbert Boyer of the University of California, San Francisco, was still the subject of dispute 10 years after Stanford first filed the patent in 1974. Cohen and Boyer developed the

Companies line up to claim rights over the genetic map

MAPPING the position of genes in the human genome will be as arduous a task as untangling the legal rights to the knowledge that will result. In the US lawyers and scientists are now trying to decide how patent and copyright laws might apply to the products of gene mapping.

Two organisations in particular have brought the issue to a head. Collaborative Research, a biotechnology company near Boston, Massachusetts, wants to patent valuable genetic markers called restriction fragment length polymorphisms (RFLPs). Everyone posseses his or her own unique complement of RFLPs. Some are always associated with a defective or missing gene and doctors can use them to diagnose a carrier of inherited disease. Collaborative Research has found about 400 RFLPs, including a marker for cystic fibrosis.

Researchers have complained that the company refuses to share its data except with a few academics who are sworn to secrecy. At a recent meeting in Washington DC, held by the US Congress's Office of Technology Assessment (OTA), Collabrative's lawyer defended the patenting of genetic sequences. "How can we communicate while trying to protect our proprietary rights?" said Bernadette Alford.

The other source of concern is Walter Gilbert, a Nobel prizewinner and founder of a new company, Genome Corporation. Gilbert says he will copyright genetic sequences just as publishers copyright words in a book. Scientists would pay to have access to his sequence data.

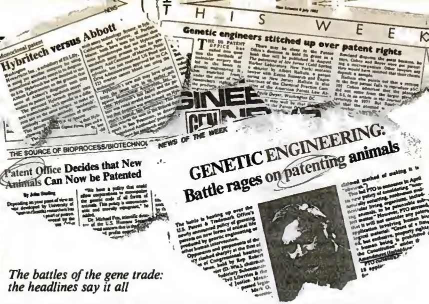
The US Patent and Trademark Office says that sequencing data from the human genome are patentable. Several patent applications are now pending, including one filed seven years ago by scientists associated with Collaborative Research. Advocates of patenting say that tradition allows experimental use of a patented invention as long as no commercial gain is implicit.

Susan Rosenfeld, a lawyer with the Association of the Bar of the City of New York, is studying copyright and genetic information: "The concept behind it is that DNA is like a computer program," which can be copyrighted, she says. Unlike patent law, however, US copyright law does not bar the commercial use of the same product if someone else creates it independently.

Christopher Joyce

Time/Steve Northrup

Herbert Boyer, one of the architects of plasmid technology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The battles of the gene trade: the headlines say it all

technique for inserting foreign DNA into a bacterial cell with the help of bacterial plasmids—circular pieces of DNA that behave like "Trojan Horses"—taking the foreign DNA into the cell under guise of it being bacterial DNA.

Stanford University, acting on behalf of both universities, filed two patents on the technique, one for the process itself and one on the products arising from the technique. Bacterial plasmids have become so commonplace in the laboratories of biotechnology companies that if the US Patent and Trademark Office approved both patents, the royalties would be worth millions of dollars. Everything seemed to run smoothly, with the patent office granting the first patent without fuss. But a couple of weeks before the patent office was due to issue the second patent, the office froze the application: it wanted Stanford to present a more convincing case for rights over the technique.

New life forms

An important part of filing a patent that involves living things is to deposit a new life form with a recognised authority. This is part of the process of describing the invention so that others can repeat it. Cohen and Boyer did not place their bacterial plasmid in a public depository, in this case the American Type Culture Collection in Maryland, which stores collections of microorganisms, until six months after they applied for a patent. In the US, as in Europe, the law says that an inventor must deposit a new organism with a recognised authority at the same time as the inventor applies for a patent. Stanford argued that the plasmid was not an organism and that other researchers did not need the plasmid to repeat the invention, so deposition was irrelevant.

Another issue that the US Patent and Trademark Office wanted to clear up was whether Cohen and Boyer's invention was published or discussed publicly more than a year before the date they filed the patent. If it was, then the patent would be invalid. This marks an important difference between American patent law and European patent law. In Europe, an inventor must not publish anything about an invention before applying for a patent. In the US, inventors are allowed a year's "grace". Unfortunately for Cohen and Boyer, a scientist, Edward Ziff, described in *New Scientist* a speech made by Boyer at a "closed" scientific conference. The article appeared on 25 October 1973, a year and 10 days before Stanford University filed for a patent. Did this article constitute a disclosure?

Stanford defended its patent successfully and, in 1984, the US Patent and Trademark Office granted the second patent to the university, which then sent letters to 100 biotechnology companies asking them to pay a licence fee in order to use the technique developed by Cohen and Boyer (*New Scientist*, 6 September 1984, p 7). At that time, the company had recouped about $3 million in royalties from licences to 66 companies. Eli Lilley was the only company selling a product made by the technique, human insulin called Humilin. Today, the university has 80 licences on the patent, each bringing in at least $10 000 a year, and 22 products are now sold that have been developed with the technique. Stanford says that it earned $1·2 million on the patent in the year 1985-86, and expects to earn about $10 million a year by 1992. Meanwhile, Cohen and Boyer have not received a penny because, in a magnanimous gesture, they waived their rights to a share in the royalties on the patent.

Stanford's patent does not apply in Europe because Cohen and Boyer published their work before filing for a patent. The year's grace in the US protected them only in the US. The lack of a similar period of grace in Europe angers many patent specialists because it appears to put European scientists at a disadvantage. The American Intellectual Property Law Association agrees that there should be a grace period in Europe: "Instead of applauding [the inventor] for making the earliest possible dissemination of information by prompt publication in a scientific journal, all to the benefit of mankind by increasing the knowledge in a particular field, we punish him by refusing to give him a patent," the association told a meeting in 1985 of the World Intellectual Property Organisation, the United Nations body concerned with international patent law.

An added frustration for European scientists is that although the US adopts a "first-to-invent principle" in the US, whereas it is the "first-to-file principle" in Europe, inventions outside the US do not count. In other words European scientists still have to file for a patent in the US, or Europe, before anyone else in order to have the patent granted in the US. There are signs, however, that this may soon change. In March of this year, Donald Quigg, the Assistant Secretary and Commissioner of Patents in the US, said: "The United States has offered the possibility of dropping its 150-year practice of granting a patent to the first inventor of an invention instead of granting it to the first person filing an application for patent protection. Moving to a first-person-to-file practice would put foreign inventors on the same footing as US inventors with respect to obtaining patent protection in the United States."

One of the most famous patent disputes in recent history involved just such a contest between scientists in Europe and America. Luc Montagnier of the Pasteur Institute in Paris filed an application for a patent for a blood test for antibodies to the human immunodeficiency virus, the virus that causes AIDS. Montagnier based his application on his discovery of the virus, before his counterpart in the US, Robert Gallo of the National Cancer Institute in Maryland. Even so, the US Patent and Trademark Office gave Gallo the rights to the patent. After the Pasteur Institute appealed to the US Claims Court, the patent office made Montagnier the "senior party" and put the onus on Gallo to prove that he invented the test first. In the end, they settled the dispute out of court.

Further disputes over patents are brewing now that the US

Peter Gardiner

Montagnier (left) and Gallo: once the centre of a patent row

has decided that it is possible to patent "multicellular animals". On 3 April 1987, the US Board of Patent Appeals ruled that scientists from the University of Washington, Seattle, who genetically engineered oysters to give them more than one set of chromosomes, called polyploidy, can patent the animals. These oysters grow larger and tastier than normal oysters; and, being sterile, do not go through the normal sexual cycle, during which time they are inedible.

Already, the environmental activist Jeremy Rifkin says that he is looking for ways of fighting the patenting of higher animals on the grounds that it is morally repugnant for companies to have rights to the genetic code of animals, Rifkin has formed a loose coalition with farmers' organisations and religious groups in the US to fight the decision. He has enlisted the support of Arie Brouer, the general secretary of the National Council of Churches in the US, who said: "The gift of life from God, in all its forms and species, should not be regarded solely as if it were a chemical product, subject to genetic alteration and patentable for economic benefits." Patenting life is now a moral issue.

The US's decision to patent multicellular animals stems from a ruling in 1980 which made it possible for the first time for scientists in the US to patent microorganisms. This case concerned a Pseudomonas bacterium that had been genetically altered to include two plasmids that enabled the bacterium to "eat" oil slicks. This set a precedent: biotechnololgy could now patent not only the altered genes, but the organisms that possess these altered genes. Going from microorganism, to plant, to multicellular animal is a logical extension of the process.

In Europe, the European Patent Convention states that governments cannot grant patents on "plant or animal varieties" (except for microorganisms). Nevertheless, lawyers in Europe, who are always keen to argue over words, now think that the convention may apply to "animal varieties", but not to "animals". Biotechnology companies will want to test this in the courts now that the US has granted a patent on a higher animal. Meanwhile, in the US, people such as Rifkin argue that patenting oysters is a short step to somebody trying to patent the highest animal of all, *Homo sapiens*. What is to stop biotechnology companies from trying such a thing now that *in vitro* fertilisation is so common and profitable?

According to Donald Quigg, the US Constitution prohibits patenting of humans: "A claim directed to or including within its scope a human being will not be considered to be patentable subject matter . . . The grant of a limited, but exclusive property right in a human being is prohibited by the Constitution." The part of the US Constitution that Quigg says will prevent biotechnology companies from patenting human beings is Article 13, passed in 1865 to abolish slavery. The question is whether the article, which applies to humans, also applies to their embryos. Could the next patent row erupt over the right to own a new type of test-tube baby? ☐

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After the goldrush

For more than a century, Alaska's gold-miners have ripped up vast tracts of land in pursuit of wealth. Now people are beginning to value the land more than the gold and miners are under pressure to change their ways

Stephanie Pain

NO ONE IN their right minds would have settled in the interior of Alaska 100 years ago. But with the first glitter of gold, sanity flew out of the window. Hordes of people travelled north where they put up with some of the harshest conditions in the world while they searched for quick riches. The goldrush was on. Perhaps because they built the State from nothing, the gold-miners have always been a law unto themselves.

Most mining claims are on public land but miners have been able to do more or less anything they liked, as if they, and not the nation, owned the land. In the early days the harsh realities of frontier life were of more immediate concern than the less tangible idea of protecting the environment. These days, other people want to share Alaska's wilderness; most have little sympathy for the miners. Last year a number of conservation groups sued the US Bureau of Land Management for allowing miners to flout rules that other industries must obey. The outcome of the case means that either the miners change their ways or they go out of business. As ever, it all comes down to money—the price of gold and the cost of cleaning up the industry.

In 1934 the US government fixed the price of gold at $35 an ounce. The price stayed constant and by the 1950s most of Alaska's mines were in decline. The low price, rising costs and diminishing returns from poorer and poorer deposits meant that few fortunes were to be made. But in the 1970s, the government left the price of gold to find its own level. As the price soared, Alaska's gold mines won a new lease of life. In 1980 the price reached $850 an ounce. In the mid-1980s the price fell again, settling down to between $350 and $450 an ounce, but this was high enough. With better methods for working the deposits, miners found it worth their while to work poorer deposits and to reopen old mines.

Most of Alaska's gold is in placer deposits (see "Going for gold in Bolivia", Box 2, p 42). The gold usually lies in gravels over the bedrock of streams. To reach the gold, miners remove tonnes of vegetation, soil and gravel that has built up over the deposit. Once they have exposed the gold-bearing gravel, miners separate the gold from the gravel, usually by washing the deposit through a sluice with water from a nearby stream.

In many mining areas, the gold-rich soils contain a high proportion of fine clay particles and sand. These particles pass through the sluice with the washwater. The water immediately below the mine is thick with sediment, which cuts out light and clogs up the streams. These days, miners cannot have a permit to work a mine unless they release less sediment into streams. At the very least, they must build pools below the mine, where the water can remain long enough for heavier particles to sink to the bottom. Even with such settling ponds, the smaller particles remain in suspension and pass out into the stream below. Controversy rages over the effects of placer mining on the quality of the water in streams. Miners protest that fish are there but "you just can't see them". Biologists protest that you can't see them because "they just aren't there".

Many miners still regard themselves as special cases and argue that they ought to receive special dispensation to circumvent the laws that control the quality of the water. Miners may be powerful in Alaska, but the state cannot break federal laws designed to protect the environment. Ernesta Barnes, a past regional administrator of the Environmental Protection Agency, insisted that gold mining should not be a protected industry. Because gold is not essential for industry or defence, the miners must conduct their industry in a businesslike manner, she argued.

Researchers are now attempting to assess the damage from gold mining. For the past two years, scientists from the University of Alaska, the Alaska Departments of Natural Resources, Environmental Conservation, and Fish and Game have been studying the streams of the Birch Creek Watershed, northeast of Fairbanks. Some streams have been mined since 1894, some never mined; some are newly worked while others are no longer mined.

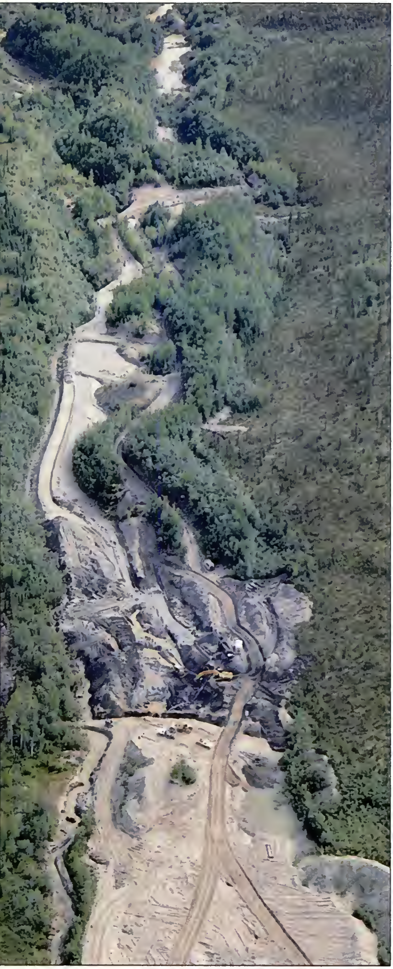
To the casual observer, the most obvious damage around a placer mine is the physical destruction. Heavy machinery tears up the vegetation alongside the stream and scours out the overburden, sometimes carrying away parts of the banks.

Recovery is a long way off

The process of scouring out the stream strips off vegetation, alters the water channels and erodes the banks of the stream. Heavy machinery can destroy meanders and pools and undercut the banks. Normally, in this part of Alaska, black spruce, willows, alders and a thick undergrowth of shrubs and herbs line the banks. In undisturbed sites plants cover almost all the bank. At mined sites, hardly anything grows. Moreover, the plants are slow to recover. According to Phyllis Weber, of the Department of Fish and Game, plants still have not begun to grow on stretches where mining stopped two years ago. In one creek, where no one has mined for 60 years, only about a quarter of the bank supports plants. The loss of vegetation deprives streams of organic material, a commodity in short supply in the subarctic. And without the shade of the streamside trees, the water heats up more than usual in the summer. The lack of ground cover makes the banks unstable and liable to wash into the stream during storms.

The sudden increase in the amount of sediment suspended in the water may look less obviously damaging than the bulldozing of banks, but sediment can devastate the life in the water. Most of the streams in the interior of Alaska are fast flowing, clearwater streams with little material suspended in them. Alaska has set limits for the turbidity, or murkiness, of stream water and on the amount of suspended sediment that will settle out. Turbidity is measured in "nephelometric turbidity units". NTUs are based on the amount of light scattered by a sample of water, and calibrated against a standard suspension of a polymer. According to the law, to protect stream life turbidity should not exceed 25 NTUs above the background level. The water in streams above mines in Birch Creek is clear; the researchers found turbidity of 0·27 NTU and suspended solids of 0·7 milligrams per litre of water. Below the only mine without a settling pond on one stream, Porcupine Creek, these figures were hundreds of times higher at 243 NTUs and 244 milligrams per litre. Where there is a series of mines along a stream, the placers can increase turbidity by hundreds or thousands of NTUs, even far downstream. At a site 92 kilometres from the last mine on Porcupine Creek, turbidity was more than 1000 times higher than at the head of the stream. According to Denby Lloyd, of the Alaska Department of Fish and Game, Alaska's standards of water quality are liberal, yet most mines are many times over the limit.

The increased load of sediment in the water has many



Photographs by Dennis and Debbie Miller

effects, most of them harmful. The presence of organisms depends on various factors: how fast the water flows, its temperature, the chemistry of the water and the nature of the bed of the stream. Increased turbidity can either raise or lower temperature by increasing the amount of solar radiation the water absorbs or by reflecting radiation back from the stream. The extra sediment reduces the amount of oxygen in the water as microorganisms break down the organic material from the soil. It also increases the alkalinity of the water and ties up nutrients by binding them into chemical complexes. Eventually, even the finest particles settle to form a blanket over the bed of the stream. The fine clay particles fill the spaces between the stones of the gravel bed and deny living space to many small animals that shelter between the stones.

Sediment has two effects on the algae at the bottom of some food chains in streams. It blankets the streambed and it prevents light from penetrating the water. Turbidity has a dramatic effect on primary production—the amount of organic material produced as a result of photosynthesis. Some of the results from Birch Creek suggest that even small increases in turbidity will dramatically reduce the productivity of a stream. Jacqueline LaPerriere and Erwin van Nieuwenhuyse, of the University of Alaska, found no sign of photosynthesis from algae in a heavily mined stream. At high latitudes, productivity is normally low, so any reduction can be calamitous. At the base of the food chain, high turbidity limits photosynthesis because sunlight cannot penetrate to the bottom of the stream. In streams near or above the treeline in the interior of Alaska, algae and plants that live on the bottom carry out most photosynthesis. At 25 to 50 NTUs, the light reaching a depth of 10 centimetres is about 60 per cent that at the surface. Between 500 and 1000 NTUs, common levels in heavily mined streams, only 0·3 to 5 per cent of the light at the surface reaches down to 10 centimetres. Theoretically, in shallow streams an increase of 5 NTUs can reduce primary production through photosynthesis by as much as 13 per cent. An increase of 25 NTUs, the accepted standard in Alaska, could reduce production by half.

Fish desert murky waters

In unmined streams, where turbidity is less than 10 NTUs and the amount of solids that will settle out is usually less than 0·1 millilitre per litre, the average rate of primary production is 0·8 grams of oxygen per square metre per day. This is a low figure for water in temperate climates but not unusual in the subarctic. Heavy mining increases turbidity to an average of 1700 NTUs and can reduce photosynthesis to undetectable levels.

Scientists at the Cooperative Fishery Research Unit and the Water Resources Center of the University of Alaska calculate that to minimise the effects of mining on aquatic life, and to ensure a quick recovery when the miners move on, mines should discharge no more than 0·1 millilitres of "settlable" solids per litre of water.

A heavy load of sediment in the water also has more direct effects. It clogs the feeding apparatus of invertebrate animals that feed by filtering particles from the water. It may also abrade their gills and spiracles, the entrances to their breathing tubes. Below mines the Alaskan biologists found fewer animals of fewer species. An average site below a placer mine contained only a tenth the number of animals found in unpolluted water and those animals the researchers did find belonged to especially tolerant groups. Mayflies, stoneflies and blackflies, all of which live in clear, fast flowing water, were rare in turbid waters. Chironomid midges, which tolerate a high load of sediment and low levels of oxygen, were often the commonest animals. In one stream 90 per cent of the invertebrates were chironomids.

Fish also desert mined streams. In unmined streams the biologists caught an average of 27 fish, mostly Arctic grayling and slimy sculpin, in every 100-metre stretch. In mined streams they caught none. There are many reasons for this.

Clearwater fish in the interior of Alaska need clean fast-flowing water. Fish populations are limited by the amount of spawning ground in summer and the amount of unfrozen water in winter. Arctic grayling and slimy sculpin, the commonest species in these streams, live on insects and invertebrates. The fish need cover or a hiding place. Grayling hide in pools and backwaters and below undercut banks. Sculpin often hide beneath stones in the streambed. Mining removes these sanctuaries. Both fish prefer cobbled or gravelly beds to spawn in. Grayling eggs collect in the crevices between stones, where they are protected from currents that would sweep them away. Sculpin lay their eggs in nests on the undersides of stones. The sediment that settles out downstream changes the character of the streambed, rendering it unsuitable for spawning. Not only do the spaces between the stones fill up, but water no longer flows through the gravel and eggs and small fry are deprived of oxygen and die.

In the absence of invertebrates, fish that stay in the streams can starve to death. Grayling, which feed by sight, have difficulty capturing insects and other small animals in turbid water. They probably avoid entering murky water. If a mined stretch of water interrupts the journey to their spawning grounds, the fish may not go there.

Rodney Simmons, a student at the University of Alaska, Fairbanks, looked at the effects of sediment on grayling. These are important fish in Alaska, ecologically and economically. Simmons placed caged fish in streams carrying a high load of sediment. The turbidity was not enough to kill them, but they grew slowly and did not build up the normal fat reserves. More important, perhaps, the gills developed abnormally, their cells multiplying and secreting excessive amounts of mucus to protect against abrasion.

Increased turbidity is visibly reducing the quality of the water. More insidious, perhaps, is the influx of poisonous heavy metals and arsenic. When gold-bearing gravels are exposed, arsenic and heavy metals associated with gold—cadmium, lead, zinc and copper—may also be freed. Jacqueline LaPerriere and colleagues at the Alaska Cooperative Fishery Research Unit found raised levels of arsenic, lead, zinc and copper in streams below active mines. When they looked at a stream where mining has only just begun, the same heavy metals were washed out into the water. Most of

One miner's reply to the environmentalists

KARL HANNEMAN is one of the new generation of miners. A mining engineer by training, he works a placer mine in the Rampart district to the north-west of Fairbanks. He describes himself as a "moderate" and is prepared to adapt to the changing demands of the law. "A lot of radical miners aren't doing much to solve the problem." he says. "But there are lots of practical measures miners can take to reduce the sediment load on streams."

Yet Hanneman is not convinced that the biologists and environmentalists are wholly right. They are blinded by emotional issues, he claims, and ignore some very good evidence that miners who use the proper techniques are not polluting streams and rivers to any significant degree. "It's not all doomsday as you might be led to believe. But gold mining's days may be numbered. No one appreciates it any more."

Hanneman believes that if miners recycle the water from their sluices and filter it through tailings, that would reduce the output of sediment to an acceptable level—less than 500 milligrams of suspended solids per litre of water. Some miners have reduced this to 100 milligrams per litre using only these methods. These levels are ten or more times below those miners have consistently pushed out for the past 80 years. The problem is, these levels are still outside the legal limits devised by the scientists.

"What do we do," he asks, "shut down the industry? We can do all that's practical but the environmentalists will still push for something better."

Hanneman thinks that the miners—at least those who are trying to improve their techniques—are hard done by. There is plenty of evidence that many mined streams do suffer in the way that Jacqueline LaPerriere and Phyllis Weber and their colleagues claim. "People aren't paying attention to the data. There are a lot of healthy productive streams now that were mined in the 1920s and 1930s. They have recovered even though no one controlled the sediment in those days," he said.

Hanneman also questions the validity of some of the recent research, such as Rodney Simmon's study of caged grayling held in turbid streams. The grayling, he says, "don't stay in the dirty water and die, they move to a clearwater tributary and live. As soon as you shut off the sediment, they come back."

Hanneman does not suggest that the good miners will have no effect on the environment, but argues that the smaller amount of sediment that they release will do no harm in the long term. The sediment that they cannot retrieve may have short term effects, such as stopping the grayling from feeding, but it will not plug up the stream substrate or cause the movement of heavy metals. "What you will have," he stresses, "is a visual effect only. If people opened their eyes, they would see that the effect is short term. As soon as mining is over, you get a rapid return to normal. A lot of people lose sight of that and say that a limit of 5 NTUs is the law so that must be the only solution. If they stick to that unrealistic aim, the industry is going to go down the tubes."

Like most miners, Hanneman thinks the environmentalists are overzealous. All the studies held up to show how awful an effect the mines have were done on rivers that receive outfall from bad operators. There are places that are excellent examples of how controls can improve matters dramatically. On one tributary of the Chatanika River near Fairbanks, the miners have reduced their output of sediment to a remarkably low level just by controlling the flow of water they discharge. In 1984, they discharged 7000 litres of water a minute and about 500 kilograms of sediment an hour. By cutting the flow to 300 litres a minute, they have reduced this load to 12 kilos an hour. Seventy per cent of the time, the water is within the legal limit of 5 NTUs, and 90 per cent of the time it is below 10 NTUs. The rest of the time no one can tell if the excess sediment has come from the mine or from rainfall runoff.

Hanneman is not convinced that there is a need to clean up every last bit of sediment by treating the discharge with chemicals, as the Bureau of Mines advocates. Besides, he points out, no one knows what effects the chemicals might have on the river systems. "Why run the risk," he says. "Why mess with what otherwise is a natural system."

One of the miners' objections to the restrictions being placed on them is that they are being tarred with the same brush as the old-timers. Most of the worst examples of pollution, with compaction of sediment, are the result of old, bad mining practices when millions of tonnes of sediment ended up in the streams.

Environmentalists, inevitably, have little sympathy for the miners but have plenty of support, not only from Alaskans, aside from the miners, but also from the rest of the United States. Hanneman asks that people look at the industry more positively. It is important, he argues, to look at what good mining techniques can achieve. "The fever is to get everyone down to 5 NTUs, the drinking water standard. That's more emotional than scientific," he says.

So far, no one has made an objective study of the problem. Research, largely ignored, has shown that the environment can recover. In 1985, the State of Alaska sponsored a study costing $250 000 on Birch Creek, one of the systems now threatened with closure. The study showed that the water in Birch Creek Village met the standards for fish growth every month of the summer. In the lawsuit against the Bureau of Land Management however, the people of Birch Creek Village alleged that the local subsistence fishery suffered because of the pollution from mines.

Karl Hanneman does not deny the impact of mines that do not control their discharge and acknowledges that this must change. What he objects to is the strong bias against the miners. "People with the interests of the natives and the environment more or less run the State government, so objective data are being suppressed, or at least not brought out. When you have no advocates your days are numbered. What the state really needs to do is to make rules so that the bad apples are history and the good apples have a threshold that they can continue to operate on." □

Pat Morris/Ardea

Environmental Protection Agency

Settling ponds remove the worst of the sludge, but Arctic grayling and other Alaskan fish need clean, clear water

the toxic metals are bound to sediment: if released they could harm aquatic organisms.

Heavy metals and arsenic do break free of the sediment particles under some conditions—in water deprived of oxygen, for example, or in the presence of certain micro-organisms. Because this happens only in certain circumstances, it may be years before the sediment releases these toxic chemicals. Some of the groundwaters around Fairbanks are so contaminated with arsenic that they are still not fit for drinking 30 years after the last large gold dredges mined the area.

Edward Brown and his colleagues at the Water Resources Center found bacteria that are associated with arsenic in the water draining from both lode and placer mines. These bacteria oxidise iron and sulphur, and probably accelerate the rate at which the toxins leach from the sediment.

One of the most shocking findings of the research is how far-ranging the damage is, both in distance and in time. Even when an area is mined for only a short time, it is difficult to repair the destruction of the stream banks and plants take many decades to grow back. Only by mechanically replacing gravels and soils and restoring the normal stream channel can miners repair the damage they did when they stripped away the overburden and diverted streams for their sluices.

Mining does not have to be a permanent blight on the environment. Invertebrates are quick to recolonise the water once mining has stopped—if the flow of water is strong enough to wash away the layer of fine sediment blanketing the streambed. Some researchers think that if miners stopped releasing excessive amounts of sediment, streams could wash the surfaces of the gravel clean in two to five years. Silt that has settled deeper in the gravel would take much longer. In places where the sediment has hardened to form a cement, the bottom of the stream is to all intents and purposes sealed up, depriving small animals of a suitable habitat for a very long time. Mined areas near to the heads of a stream recover sooner than those downstream. The steeper gradient and the faster flow of water, especially after storms, is usually enough to wash the gravel clean and allow animals to recolonise the bed. Further downstream, where the gradient is shallower, water moves more slowly and the sediment will pollute the streambed for many years.

If miners can rehabilitate some of the more physically damaged sites and encourage plants to grow along the banks of streams, their one remaining problem is to prevent the huge flush of sediment into the water. Now that the mines face closure if they do not comply with water regulations, miners are looking for ways to clean up their effluent. Settling ponds are now obligatory, though there are still a few mines without them. Miners dig settling ponds just below the sluice outflow, often in a series, and remove much of the heavier material suspended in the water. How effective a pond is depends on how well it is built and how well it is maintained. Ponds must be cleaned regularly to ensure that they will hold water long enough for the sludge to settle. The sediment must be removed and stored to be spread over the land later. Settling ponds can remove not only a proportion of the turbidity but also some of the heavy metals that would otherwise be flushed into the stream. But the ponds do not catch the fine silt and clay and the metals bound to these smaller particles.

Another way to reduce the amount of sediment that ends up in streams is to recycle the wastewater through the sluices that wash the gold-bearing gravels. In other parts of the US, miners recycle their wastewater indefinitely. The Environmental Protection Agency, which is currently formulating new rules for the placer industry, will probably insist on continuous recycling. The miners object strongly because, they say, recycling is expensive and it hinders the recovery of fine gold particles. Where it is used it

As gravel washes through a sluice, gold drops out but mud passes on downstream

Dennis and Debbie Miller

The old Alaskan gold dredges scooped up gold-bearing gravels, sorted them, and threw the waste behind. Decades later, little grows on the snake-like piles of tailings

Dennis and Debbie Miller

normally supplements settling ponds, when the miner diverts water from the last pond back to the sluice. No one yet has an efficient way to prevent fine particles reaching the stream.

One promising treatment, advocated by the Bureau of Mines, is to add chemicals that cause the fine particles to aggregate and sink. This technique is at least 4000 years old. Ancient texts from India from about 2000 BC suggested adding vegetable substances to water to clarify it. Since 1889, water companies in the US have treated drinking water with chemical clarifiers. Other mining industries have found a variety of coagulants and flocculants effective in treating their wastes, but so far none has caught on in the placer mining industry. At the moment they are thought to be too expensive and too inefficient in the conditions in the far north. Some do not work well at low temperatures or do not disperse well. However, chemists from the Metallurgy Research Center at Tuscaloosa, Alabama, have spent several years experimenting with a particular technique they think will fit the needs of Alaska's miners. After years of laboratory experiments with a water-soluble resin called polyethylene oxide (PEO), Annie Smelley and Bernard Scheiner and their colleagues conducted their first trials at placer mines in Alaska last year. Their method showed promise: this summer they are back in Alaska to refine the technique.

PEO is an effective flocculant for small clay-sized particles. The method devised by Smelley and Scheiner involves mixing PEO with the clay suspension, which forms a floc with the small particles, then removing the water from the floc and disposing of the waste. The big advantage of PEO is that, in refined forms, it is not toxic, unlike some settling agents. Pure PEO is so inert that the US Food and Drug Administration allows its use in food manufacture.

It is possible to enhance the clarification of water treated with flocculants by passing the water through a filter of sand, a common technique in other parts of the US. This can effectively remove most of the remaining particles except the finest clays. The filter works rather like blotting paper. As water drains through a pond lined with a layer of sand, the sand "captures" the particles, mostly in the top few centimetres. As the top layer becomes full of clay, the miner can strip off sand to expose a clean layer. At placer mines, miners may be able to build similar filters from mine tailings or gravel. These would be cheaper and easier to build in remote parts of Alaska. Even without chemicals, filters help remove some sediment.

Miners are opposed to most of the suggested changes to their industry. They blame conservationists for trying to shut them down. In part this is true. Last year, the Northern Center for the Environment, the Sierra Club and the Environmental Defense Fund sued the Bureau of Land Management for not protecting the environment according to federal law. The bureau, they claimed, was not complying with the National Environmental Policy Act because it had not made environmental impact studies on mining operations. Nor, they pointed out, had the bureau conducted the necessary reviews of the damage mining might be doing to subsistence fisheries. Ironically, during the legal battle, the banks became the most effective protectors of the environment. Unsure of the outcome of the case, banks were reluctant to finance mines. Many miners went out of business. Many more are likely to follow them in the coming year.

The conservationists won their case. The judge ruled that miners could carry on their business this year, but from October all mining has to stop until the Bureau of Land Management has completed its assessments of mining's impact on the environment. The review will probably take 18 months, so the miners will lose a whole season's work. If they survive that, they will inevitably have to change their operations and that is likely to be expensive. But, at the end of the day, a gold mine is a business like any other. There is no reason why they should bend the rules that apply to other industries. □

Going for gold in Bolivia

Thousands of prospectors are heading for the Amazon jungles in search of gold. Tipuani in northern Bolivia with its rich gold fields is the goal for many

Stewart Redwood

A rough road cut into the mountain's side leads to Tipuani, the centre of Bolivia's gold rush

All photographs by Stewart Redwood

A TRADITIONAL gold rush is under way in the steamy jungles of the Amazon. In the 19th century, prospectors headed for California, Australia, Alaska and the Klondike. Now would-be millionaires are flocking in their thousands to gold fields scattered throughout the Amazon Basin of Brazil and the upper reaches of the Amazon in Bolivia, Peru, Ecuador, Colombia and Venezuela.

A dramatic increase in the price of gold in the late 1970s prompted this gold rush. Governments also backed the exploitation of the South American interior—the gold rush was an added incentive. In Brazil alone, half a million prospectors and many mining companies are working in the gold fields. Most of the prospectors are struggling simply to survive in the desperate economic climate in South America. A lucky few, however, make their fortune. A prospector, Julio de Deus Filho, found one of the largest gold nuggets ever, the Canaan nugget, at Serra Pelada in Brazil in 1983. The nugget weighed 51 kilograms, and Filho sold it for $1 million.

Many of the Amazon gold fields, such as Serra Pelada, are new discoveries. However, mining of many other deposits is just the latest phase in a long history of gold mining in the region. In the Upper Amazon basin, Tipuani is a typical example. Its gold fields are in the Andean foothills of northern Bolivia. They are the richest in this province of gold-bearing rivers which drain the Eastern Cordillera of northern Bolivia and southern Peru. The gold lies in the sediments in

1: Placers: how river gravels reveal gold

SEDIMENTARY deposits of gold, or of any other heavy mineral which resists corrosion, are called placer deposits (pronounced "plass-er"). This is an old Spanish name for a sandbank, and early Spanish miners in Latin America employed it to denote "a place in a stream where gold was deposited". Placers have been called the pauper's gold deposits because they are easy and cheap to work, compared with underground mines. This belies their tremendous value, and many a pauper has become rich from them.

Many fossil placers exist, including the world's single largest source of gold, the ancient Witwatersrand deposits of South Africa. They formed in the same tectonic setting as the Tipuani deposits, that is, in a foreland basin on the continental side of an Andean-type arc. Tipuani is not the modern equivalent of the Witwatersrand but the tectonic setting is similar. Between them, modern and fossil placers have provided more than two-thirds of all the world's gold.

Gold is liberated from its host rock by the natural forces which reduce mountain ranges to sediments. Mechanical and chemical weathering break rock down. Water, wind and glaciers transport weathered debris. This causes erosion, and further breakdown of the detritus and the land surface by abrasion.

Gold is much more resistant to weathering and erosion than other minerals. It remains in its native state and is transported as gold grains, even after erosion has freed it from the bedrock. Eluvial placers form when rain washes fragments of gold-bearing rock from the bedrock. They are found where they formed. On the other hand, when gold-rich rocks shatter or break from cliffs, they become colluvial placers. Here, the placers may form at some distance from the parent cliff. Beach placers appear along shorelines.

By far the most important are alluvial placers. In these, the gold is transported along with other sediments by rivers. Because of its much higher density, gold drops out of the current as soon as the force of water slackens. This can happen, for example, following a flood, or in the slack water inside a bend or where a tributary joins the river. Water also slackens in the lee of an island or boulder, or in a crevice, pothole or plunge pool in the river bed. Water and gravity do all the work to free and concentrate the gold. All the prospector has to do is find the actual bed or zone in the sediments that contains concentrations of gold.

Gold mechanically moved by water ranges in size and shape from abraded and flattened grains to dust. But gold is far from the inert metal it is popularly believed to be. Chemical and biological processes can play an important part in the formation of placer deposits. Gold is soluble and can be transported in natural solutions, such as chlorides, cyanides, thiosulphates and humic acids.

Organic matter, such as bacteria, algae and plant tissue, can bind or absorb gold, and can carry it and precipitate it from solution. Indeed, certain algae are used to recover gold and other precious metals in industrial leaching operations. Gold may thus grow in situ in placer deposits, and this may help to explain the formation of nuggets. For example, chemical and biological processes played a major part in the formation of the Witwatersrand gold deposits, 2·7 billion years ago. There, extensive mats of algae trapped and absorbed gold. These now form organic marker seams in the mines. ☐

Miners sieve gravels for grains of gold. Cooperatives finance dredges and sluices for more efficient extraction

the valleys and river beds but its source is high in the Andes. You have to go back nearly 600 million years to trace the history of these deposits (see Box 2).

People have worked metals, such as gold, silver and copper, in the central Andes for almost 4000 years. The main source of gold has been the placer deposits, formed from gravel rich in gold in ancient river beds, of the Tipuani and the other eastern valleys, such as Carabaya in southern Peru (see Box 1). The kingdoms of the Aymara in the 13th to15th centuries and the Inca in the 15th to 16th centuries were important gold producers. They maintained colonies of mines in these valleys. Miners have discovered Inca tools, ornaments and other relics at Tipuani. This wealth was the Incas' downfall. Their treasure fell into the insatiable hands of the Spaniards after the conquest of Peru in 1532. Interested only in the bullion value of gold, the conquistadores melted down the lot.

The Spaniards took 30 years to discover the source of the gold. They paid little attention to Upper Peru, the land which is now Bolivia, until the discovery of large silver deposits at Potosi in 1545. The Spaniards built the city of La Paz, now capital of Bolivia, shortly afterwards in 1548. Strategically placed between the silver mines and the colonial capital of Cuzco, La Paz was able to exploit the discovery of rich placer deposits of gold in nearby valleys. "It is a land well known to be fertile in gold," wrote Father Barba, a miner, in 1697, "and during the rainy season boys find nuggets in the streets." From La Paz, Spanish expeditions set out north into the jungles in the foothills, searching for new mines. They redis-

2: Mountain-building, erosion and gold

THE MOUNTAINS of the Eastern Cordillera consist of a thick sequence of marine sediments, laid down between 590 and 360 million years ago. Strong folding occurred in the sediments which forced large masses of molten rock into them. As the molten rock crystallised to form vast bodies of granite, it drove fluids rich in gold into fractures in the surrounding sediments. There the fluids solidified to form veins of quartz and gold. As the granite and its veins formed while folding of the sediments was still going on, they were deformed in a similar way to the host sediments since these events. Granite rocks and veins formed during subsequent mountain-building events are not deformed, and carry little gold. Instead, they bear tin, and now form the northern part of Bolivia's famous tin belt.

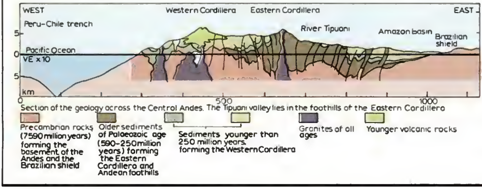
Miners have exploited the gold-quartz veins in the mountains on a small scale. However, the erosion of these veins by rivers has created much richer gold deposits that are vastly more extensive. Rivers have carried the gold down into the valleys of the Andean foothills, such as Tipuani. The resulting sedimentary deposits of gold are known as placer, or sedimentary, deposits.

Placer deposits formed in several stages in the Tipuani region. Episodic uplift created the Andes over many millions of years. With each new uplift, intensive erosion and river cutting begins to wear down the rejuvenated mountains.

The oldest placer deposits at Tipuani are ancient river channels filled in with red, solidified gravel. Called cangalli deposits after a village on the river, these channels follow a different course and a steeper gradient than the present rivers. In places, the channel runs through ridges 100 metres above the present valley-bottom. Yet 10 kilometres downstream, the base of the fossil channel lies 200 metres below the modern river level at Tipuani. Sediments rich in gold, or paystreaks, in the cangalli are found in hollows in the base of the channel and downstream of small islands. Intense erosion scored out these channels, following a major uplift of the Andes about 10 million years ago, in the late Miocene period.

Between 200 000 and 100 000 years ago, another upheaval of both the Cordillera and of a mountain block to the east of Tipuani occurred during the Pleistocene, when glaciers abounded. This upheaval formed a closed drainage basin between the Cordillera, the River Coroico and Apolo. Gravels washed down from the glaciers in the Cordillera blanketed the basin to a depth of 700 metres. However, they contain very little gold.

The present valley system began to develop during the last period of glaciers, about 30 000 years ago, after more movement in the Cordillera. Movement in the Earth's crust raised and folded the land and rivers cut down through it, creating six terraces on the sides of the modern Tipuani valley cut into both cangalli and bedrock. These terraces all contain gold. The present river channel and its beaches, or playas, produce most of the gold. As well as depositing gold that has been newly eroded, the present rivers wash through many of the older placer deposits. □


WEST
Western Cordillera
Eastern Cordillera
EAST
Peru-Chile trench
River Tipuani
Amazon basin
Brazilian shield
Pacific Ocean
VE x 10
5
0
5
km
0
500
1000
Precambrian rocks (7590 million years) forming the basement of the Andes and the Brazilian shield
Older sediments of Palaeozoic age (590-250 million years) forming the Eastern Cordillera and Andean foothills
Sediments younger than 250 million years, forming the Western Cordillera
Granites of all ages
Younger volcanic rocks

Section of the geology across the Central Andes. The Tipuani valley lies in the foothills of the Eastern Cordillera covered the gold fields of Tipuani and began to mine them in 1566. A colonial goldrush began in the early 17th century. It lasted almost two centuries. The Spaniards conscripted Indians to work the mines and imported black African slaves.

The Indians' mining techniques were primitive and wasteful. They dug rabbit-like burrows into the loose sediments, which bear the gold, in the sides of the valley. These tunnels often collapsed. A geologist wrote in 1861: "Frequently, later explorations have disclosed the mummies or skeletons of unfortunate Indians who have perished in these narrow and tortuous holes, buried along with their mining implements." Such mining practices still go on at Tipuani.

Spanish prosperity from the gold rush came to an end when the Indians rebelled in 1780. The Indians captured and looted the province. They destroyed and besieged La Paz. Many of the trails to the gold fields and many of the colonial gold mines are said to remain lost to this day. Mining soon revived at Tipuani, but after Bolivia's independence in 1825 gold mining was generally neglected. Foreign companies attempted several mining schemes, without success. The most notable exception to the 19th-century neglect of Tipuani was a Bolivian entrepreneur, Villamil Blanco, who mined gold worth more than $2 million there. During the middle of the 19th century, gold mining declined throughout South America and Brazil ceased to lead the world in gold production, a position it had held since 1700. The abolition of slavery and the great gold discoveries of California and elsewhere hastened the decline of Amazon gold.

Only one systematic evaluation was ever made of the gold reserves of the rivers around Tipuani. The Aramayo mining company undertook it between 1935 and 1952. The company intended to mine the rivers, but the Second World War and then the nationalisation of mining in 1952 frustrated its plans. Aramayo did mine the deposits in the 1940s, but the operation was unprofitable. The company's evaluation of the river below Tipuani was not wasted, though. Another company, South American Placers, has operated a floating gold dredger on these rivers since 1960. A few independent miners have worked the gold deposits in the Tipuani area since the 1950s. In the past 10 years, however, thousands of Bolivians have flocked to the gold fields.

Taking the high road

It takes a day or more to get from La Paz to Tipuani by a narrow and tortuous dirt road that hangs from the cliffs in places. Tipuani is one of the few valleys in this province that is rich in gold and accessible by road. Once, the journey took a week by mule and canoe. Guanay and Tipuani, the centres of the gold rush, are small boom towns with a "Wild West" atmosphere. The road from Guanay to Tipuani climbs through jungle and along precipitous ridges. On the horizon the snowy peaks of the Cordillera reach altitudes of 7000 metres. The main gold-mining area lies in the Tipuani valley where it widens out for about 10 kilometres. Scattered among the river's meanders are the gold diggings. Polythene shacks lie around haphazardly among the diggings, surrounding the old town of Tipuani. The river is full of men washing gravel in pans or sluices.

Most miners group themselves into cooperatives to buy trucks, bulldozers and washing equipment. The World Bank, through the Bolivian Banco Minero, provides much of the credit to purchase plant. A typical cooperative has about 50 members working a concession of 120 hectares. It can produce up to 20 kilograms of gold each month—at current prices worth more than $250 000. More than 250 cooperatives mine the Tipuani area. The official figure for gold production from Tipuani in 1982 was 1250 kilograms. A more realistic estimate, however, puts the figure at around 10 000 kilograms, the difference being in the huge amounts smuggled out of the country.

Diggers and bulldozers excavate the gold-bearing gravel. Trucks then take it to one of the large concrete washing plants which line the river banks. The gravel is dumped into a hopper inside the plant, and washed through a vibrating screen, to sieve out boulders. Smaller sediment washes through the screen and on through long wooden sluice boxes. These trap the gold grains by the same principle as the natural formation of gold placers. Wooden slats, or riffles, placed across the floor of the sluice create eddies of slack water. The heavy gold grains drop out of the flow, while the sand and gravel are swept away. Water and gravity do all the work.

Efficient extraction

Mining companies are keen to get in on the act in Bolivia. They have organised many exploration and evaluation programmes in the past 10 years. However, state and national companies run the only large-scale mining projects in the country. Working methods at Tipuani are highly inefficient because more than two-thirds of the gold in the sediments is lost. One of the strongest arguments for the mining companies' case is that they could recover gold on a larger scale, much more efficiently and provide greater revenue. Foreign mining companies are wary of committing themselves as the political and economic risks are so great. The Bolivian government appears keen to allow the present gold rush to continue, as it might alleviate some of the country's massive unemployment and poverty. Its neighbour, Brazil, has set aside official *garimpos*, or gold fields, such as Serra Pelada, protected from the activity of mining companies by decrees.

Problems that have always suppressed the gold-producing potential of this rich region hamper the present gold rush. Poor communications and transport to world markets have held up economic development in Bolivia. These problems are compounded at Tipuani by the severe terrain, remoteness and poor access.

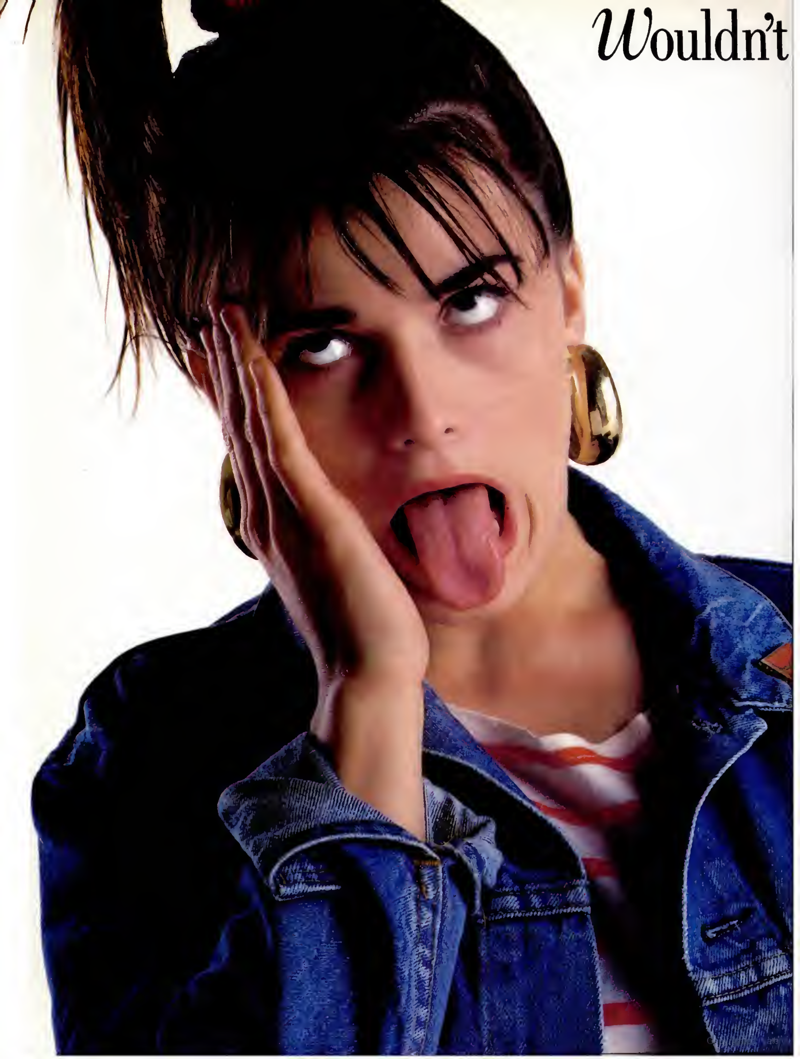
Scarcity of labour has always been a problem. The population with traditional mining skills lives in the mountains. Mountain Indians, however, are reluctant to change their lifestyle and move down to the humid and unhealthy jungle. Similarly, colonisation schemes aimed at cultivating the lowlands have had limited success. Mining schemes in the past 150 years had to make a big effort to induce and keep a workforce. The Incas and Spaniards avoided the problem by conscripting Indian workers; the Spanish also brought in black slaves. The present gold rush is different because miners are self-motivated.

At the root of Bolivia's problems is the political and economic instability of the country, with more than 200 presidents in 162 years of independence, a national debt of $4 billion and uncontrollable inflation. Despite its rich resources, Bolivia's economy depends too much on a single commodity, tin. The tin mines in the Andes have been in decline, after many years of neglect. Economic disaster was inevitable when the world tin market collapsed in 1985.

In the late 1970s the price of gold shot up. Gold suddenly became an even more profitable and attractive metal to exploit. The reasons for the dramatic price increase of gold date back to 1971, when the US abandoned the gold standard. The price of gold had remained fixed at $35 per troy ounce (31·1 grams) since 1934, following the Wall Street crash, and had a lot of leeway to make up. Spurred by the world crises in 1978, the gold price rocketed, reaching $850 an ounce in 1980. In the mid-1980s, the price has settled at $350 to $450 an ounce.

The soaring gold price revived world interest in gold mining, and prompted the latest Tipuani gold rush. Despite formidable problems, gold has been mined at Tipuani by successive civilisations for centuries. In Bolivia, it now provides wealth and prosperity for some, and a livelihood and hope for many more. □

Stewart Redwood works for the British Geological Survey in Edinburgh.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Midland
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Remote sensing and the whole world picture show

A growing range of artificial satellites, sensors and computers is bringing new insights of the Earth's surface for use by farmers, meteorologists, geologists and many more

Garry Hunt and Richard Fifield

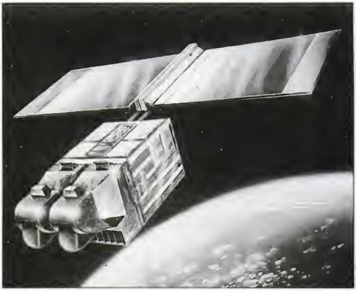
ATTEMPTS to view the land from high above the Earth have a long tradition, stemming from the early days of ballooning in the 18th and 19th centuries. Military strategists from the Napoleonic wars onwards knew the advantages of a bird's-eye view of the battlefield. Later in the 19th century, scientists sent cameras aloft strapped to pigeons or balloons. In the First World War, the military used not only balloons and pigeons but also aircraft as platforms for cameras. By the Second World War, aerial reconnaissance was playing a significant part in planning and implementing military initiatives. Cartographers increasingly turned to aerial photography in their surveying and mapping.

Not until 1 April 1960, three years after the launch of Sputnik 1, the world's first artificial satellite, did anyone see what the Earth looked like when viewed from space. Then, the US National Oceanic and Atmospheric Administration (NOAA) launched a Television Infrared Observation Satellite, Tiros-1. Images from more recent NOAA satellites and the European Space Agency's Meteosat now make regular appearances in television versions of the daily weather forecast.

The ability to view the Earth from space is big business when it comes to meteorological forecasting. In 1986 alone, the Civil Aviation Authority in London paid the Meteorological Office more than £15 million for its weather forecasts. Airlines use the forecasts to plan routes and to save fuel. Shipping lines and the oil industry are also major users of maritime weather forecasts. However, weather is not the only business to benefit from accurate views of the Earth from space. Remote sensing, as it is known, is becoming increasingly important to local authorities, exploration geologists, surveyors, the military, map makers, fishermen and others.

In the 1960s, through the National Aeronautics and Space Administration, the Americans began to plan the first satellite suitable for surveying the Earth, its surface and resources with a definition, or "resolution", of 80 metres rather than that of the meteorological satellites, which could cope only with details greater than a square kilometre. NASA launched the first Earth Resources Technology Satellite (later renamed Landsat 1) in 1972. Over the next 15 years, the agency launched Landsats 2 to 5, providing a continuous service to many countries.

Optical instruments on the satellites measure the varying intensity of electromagnetic radiation reflected by the Earth's surface. The sensors are not limited to measuring light, but can also detect electromagnetic radiation outside those wavelengths that the human eye can see. Landsats 1 to 5 have all carried a Multispectral Scanner System, which can detect two bands in the visible part of the electromagnetic spectrum and two in the infrared. Landsats 4 and 5 also carried a more advanced sensor called the Thematic Mapper. This has seven bands, three in the visible and four in the infrared. The increase in resolution makes it possible to detect features on the ground as small as 30 metres. The Multispectral Scanner System and the Thematic Mapper both scan across a strip 185 kilometres wide, constructing an image of the land below as the satellite travels along its orbit. Spot, the commercial remote-sensing satellite that the French launched in February 1986, has a highly original sensor which can collect data from different directions. Scientists can use the data to create three-dimensional images and then derive heights of any feature shown. Spot can detect details as small as 10 metres and resolve heights with an accuracy greater than 5 metres.



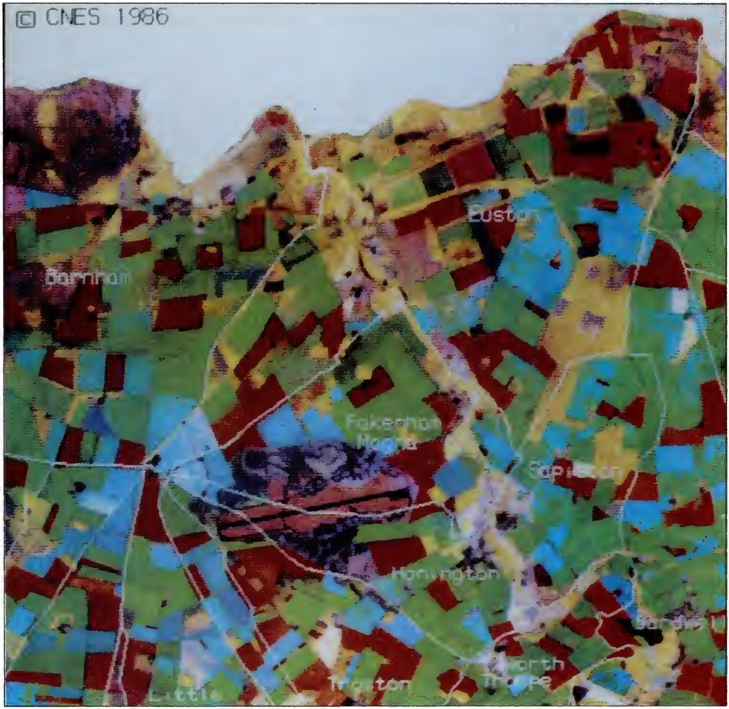
Daily Telegraph

Spot, France's Earth resource satellite

Unlike optical techniques, radar instruments used in remote sensing provide their own source of microwave illumination. For this reason, scientists call them "active" sensors to distinguish them from the "passive" optical ones. So far, there has been only one radar satellite, the American Seasat, which was launched in 1978. Sadly, Seasat failed after 100 days, but during its brief life the radar instruments on board provided detailed oceanic information on wave and wind conditions, and were even more accurate than the designers of the satellite predicted.

To obtain images of high resolution by techniques involving microwave requires that the satellite has a large antenna. This is not feasible because of the limitations on the size of the payload of a satellite. However, Seasat overcame these problems by an ingenious technique. The synthetic aperture radar, as its name implies, synthesises, or "builds up", its antenna as the satellite travels along its orbit, thus providing images of high resolution. Variations on the radar's images occur as a result of microwaves being reflected with different intensities, which in turn depend on the roughness of the surface and the molecular properties of the area being imaged. The images that are generated by radar systems are quite different from those detected by the passive optical instruments.

For the purpose of remote sensing, scientists place satellites in a polar orbit, which means that the satellites orbit 800 to 1000 kilometres above the Earth. As they journey around the planet, they pass over regions near the North and South Poles during each revolution. The flattening of the Earth in the polar regions perturbs the orbit of the satellite, and the orbital plane starts to precess. The effect is rather like the precession of a spinning top in which the spin axis of the top rotates about the vertical axis. The overall effect is that the orbit precesses a few degrees each day. The satellites travel at speeds in the order of 27 000 kilometres an hour. They take roughly 100 minutes to complete an orbit. Landsat 5 takes



NRSC

Index of vegetation around Bury St Edmunds, Suffolk. The overall image is produced from three images detected by sensors on the Spot satellite and reveals the distribution of crops: wheat and barley are shown in green, potatoes in red, and grassland blue

233 orbits before it completely covers the world.

The data relating to the images are built up by the sensors and stored on tape recorders. They are transmitted to the ground when the satellite is in range of a receiving station. Turning the raw data into images recognisable to the human eye has become a science in its own right (see Box). The data produced by the synthetic aperture radar on Seasat and the Thematic Mapper on Landsat 5 are too vast to be held on board. Instead, the data are available only when they can be collected and relayed to a ground station simultaneously. This puts considerable constraints on the coverage of the systems. In 1985 NASA launched a Tracking and Data Relay Satellite System. By means of this, data can be relayed to receiving stations from Landsat providing images of areas that would otherwise be out of sight. However, the programme was set back by the ill-fated Challenger Mission on 28 January, 1986, because part of its payload was a second tracking and relay satellite.

A worldwide network of sophisticated ground stations now receives the data from satellites. The stations cost millions of dollars to build and run, so NASA cooperates with host nations wherever it installs receiving stations. At present, there are ground stations for Landsat in Argentina, Australia, Bangladesh, Brazil, Canada, China, India, Indonesia, Italy, Japan, Pakistan, Saudi Arabia, South Africa, Sweden and Thailand. Data from the meteorological satellites are transmitted at much lower rates and receiving stations for these can be as low as £50 000. The NOAA has devised an Automatic Picture Transmission system that allows reception of meteorological data at an even lower rate, so the cost of an installation can be less than £500.

Once the data have reached a receiving station, inter-

Turning the numbers into a range of pictures

DATA from imaging sensors are transmitted to the Earth as of a stream of numbers, in "digital form". Each image is made up of a large number of rectangular picture elements or pixels which form a grid. For each pixel, the digital value will represent the intensity of the signal received at the sensor from the corresponding area on the Earth's surface. To construct the data stream into a form interpretable by the human brain requires the assistance of a powerful computer coupled to a graphic display screen of high resolution. By allocating a different sensor band to each of the red, green and blue colour guns in the display screen, it is possible to combine data from any three bands to form a coloured image.

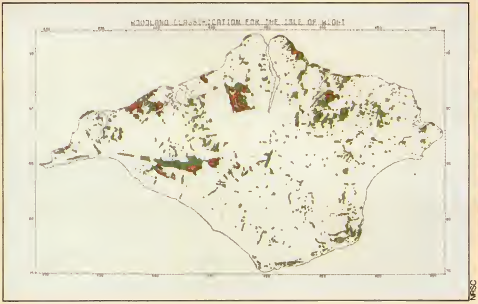
Raw images cannot, at this stage, be overlain with map data because of the distortion introduced by the angle at which the sensor made its measurements and because of the curvature of the Earth. Computer systems must be used to warp or transform images onto standard map projections. This is done by identifying a number of control points on both images and maps and appropriately transforming the images.

The techniques of computer analysis of satellite imagery can be broadly termed image processing. This is not, however, limited to satellite data but is used in such diverse fields as medical science and astronomy. A number of sophisticated systems for processing images have been developed that allow scientists to manipulate images interactively. Image enhancement is likely to be the first technique to be employed and scientists use it to enhance the features that interest them. In its simplest form, this may only involve stretching the image contrast to help the eyes to differentiate even the most subtle changes in shade. Many more techniques for enhancement are possible, some of which involve extremely complex processes that emphasise features with particular orientations, intensities or frequencies. These techniques may produce images that have little in common with the original one and can be interpreted only by scientists experienced in remote sensing, to whom they may reveal a wealth of information not visible on the original image.

With geological and agricultural applications, it is essential to be able to classify the image into areas that show similar characteristics. This may, in its simplest form, involve only identifying areas of one band that fall between two levels of intensity. Scientists have developed more complex classifications that they can use to identify areas that show similar spectral characteristics in all bands of the sensor. If they can find a crop or mineral deposit on an image, or if they can correlate it with information confirmed at or near the ground ("ground truth"), they can feed it into the computer. The computer will then be able to identify other areas of the image that show similar spectral relationships and intensities to the control data, highlighting potential mineral deposits or mapping the distribution of particular crops. □

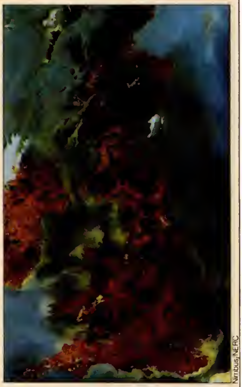
Crown Copyright

A chart plotter at work at the Meteorological Office's headquarters in Bracknell



NRSC

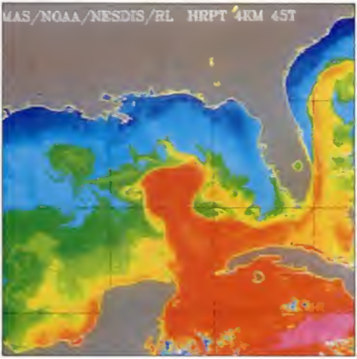
Woodland classification of the Isle of Wight from data collected by the Thematic Mapper aboard Landsat. The deciduous trees are shown in green and the coniferous ones in red


Nimbus/NERC

A view of Britain and Ireland from a Nimbus satellite prior to processing to overcome the distortion

national distribution networks disseminate them to users. These networks involve the collaboration of many governmental and commercial agencies. The National Remote Sensing Centre (NRSC) in Farnborough, Hampshire, is Britain's agent for Earthnet, the European Space Agency's network for disseminating remotely sensed data. At present, most of these networks transfer data on magnetic tapes using couriers and postal systems. This seems ironic considering the technology required to obtain the data. However, it reflects the fact that most applications of remote sensing, other than weather forecasting, do not require to receive the data in real time, that is to say at the same time as the ground station receives them from the satellites. All the same, scientists are developing more sophisticated techniques to transfer data quickly and efficiently. In a recent pilot study, one of the receiving stations for Landsat transmitted data directly to the NRSC. The centre could then monitor the daily development and movement of icebergs off the Greenland coast. The Royal Aircraft Establishment's receiving station at Lasham, in Hampshire, is linked by British Telecom's Megastream network to the Meteorological Office in Bracknell, and so the forecasters at the Met. Office can incorporate quickly the data from meteorological satellites into their numerical models.

Today, the environment is a political issue, so people are seeking new ways to explore and to monitor it. Besides its use in many national efforts, remote sensing is central to

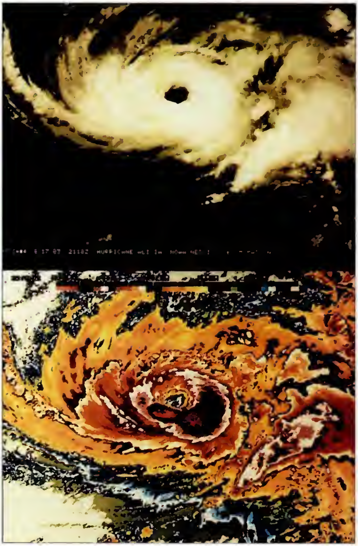


Legeckis/Science Photo Library

False colour image of the distribution of heat in the waters of the Gulf of Mexico showing a loop current (red) flowing around Cuba

many international programmes concerned, for example, with observing and modelling global climate. These studies require the assimilation of widespread, simultaneous measurements over time scales from months to decades. Operational meteorological satellites, backed up by experimental missions such as Seasat, collect the data. One major international programme monitors ice in the seas of the polar regions, because ice greatly affects the transfer of heat and moisture between the surface of the sea and the atmosphere. Ice thus plays a critical part in weather in the high latitudes and in modulating the Earth's climate.

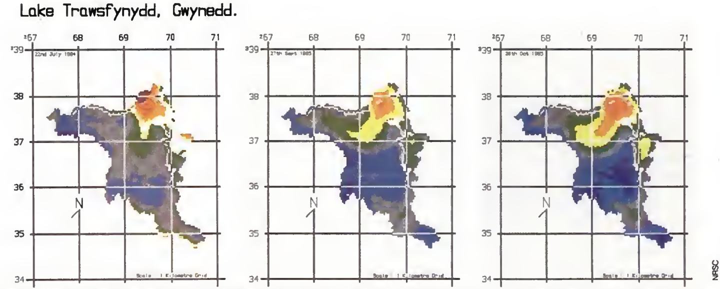
Remote sensing by satellite provides data over even the most hostile seas of the world, so oceanographers make good use of it. Although satellites such as Landsat and Spot can provide detailed and valuable information for coastal zones, they are not suitable for studies on the very large scales that oceanographers need, for example, in their work on ocean basins. To do this, they need special "dedicated" missions.



NOAA/Science Photo Library

Satellite image of Hurricane Alicia taken with an infrared scanner

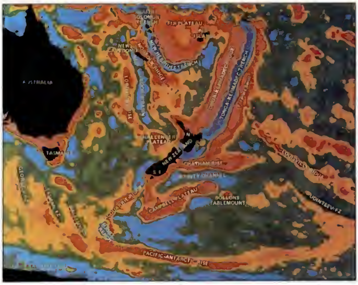
Marine biologists can gain information on the concentration of phytoplankton from the colour of the oceans. The Coastal Zone Colour Scanner on the Nimbus 7 satellite provides data which the biologists would find difficult to collect in even the most extensive of marine campaigns. With



NRSC

Three different images from the Thematic Mapper aboard Landsat showing how large volumes of cooling waters from a power station on the northeastern shore of Lake Trawsfynydd circulate through the lake and produce strong thermal gradients such data, they can calculate the primary productivity of the oceans. This information is of special significance to the fishing industry, because phytoplankton are at the base of the marine food chains and thus greatly influence the distribution of fish. The NOAA has already undertaken a number of experimental programmes in which it provided Californian fishermen with charts indicating the likely whereabouts of Albacore tuna shoals. Such information, showing colour and temperature, saved the fishermen valuable time and fuel.

Seasat's microwave payload included not only imaging instruments such as the synthetic aperture radar, but also a wind scatterometer, which measured wind speed and direction. The payload also included a radar altimeter which provided detailed information on wind speed, wave height and wave direction, as well as detailed information on the height of the satellite above the sea surface to an accuracy of a few centimetres. From these data, geophysicists developed maps showing the shape of the seabed over the entire globe. They did this by studying the overall shape of the sea surface, which, ignoring waves and variability caused by currents, is controlled by the local gravitational field, and this in turn is influenced by the depth of the sea.



False colour map of the floor of the Pacific prepared by computer processing data from Seasat. A variety of previously unknown geological features are revealed, including the chain of sea mounts running northeast of the Tonga-Kermadec trench

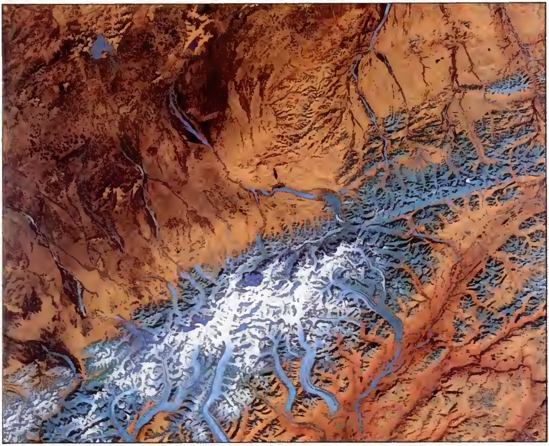
NASA

European hopes for the 1990s

The next satellite for studying the oceans by remote sensing will be ERS-1. This is the first in a series of satellites which the European Space Agency intends to launch from 1990. ERS-1 will carry a full payload of microwave instruments; a synthetic aperture radar with a resolution of 25 metres, similar to that flown on Seasat, scatterometers, an altimeter and a radiometer that measures temperature in a series of discrete bands. The satellite will be able to work in all kinds of weather and will produce its images, regardless of day or night. Oceanographers, meteorologists and climatologists are interested in the information on wind fields, wave height, ocean currents, tides and so on. Such information will also be useful to people in the planning of offshore operations, designing offshore installations, planning shipping routes and monitoring fishing grounds.

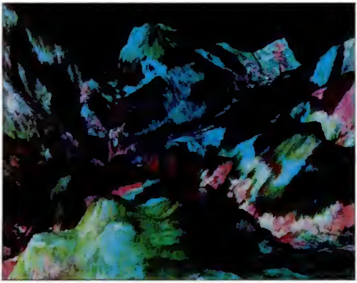
Remote sensing can play an invaluable part in geological mapping and exploration. In particular, geologists can use the techniques of image processing to identify faults and fractures, concealed folds, and to detect areas rich in minerals. Satellite imagery is ideal for quick, cheap appraisals of the geology of regions that no one has mapped. A single Landsat scene, which covers 33 500 square kilometres, allows geologists to identify and to map major structural features such as folds and faults and large-scale breaks in geological sequences.

Images that may reveal or hint at the presence of geological structures containing minerals or oil are useful in exploration. For example, a team of geologists using data from Landsat detected the line of a geological structure in an area of Bay County, Michigan. The team believed that the structure contained an oil reservoir, but they could not sell their survey to oil companies because the companies were then sceptical about the usefulness of remote sensing. After persuading an independent petroleum company to undertake a seismic evaluation and to drill the area, the team confirmed the presence of the structure and the reservoir. The conventional work cost $125 000 while the Landsat study cost $25 000—a cheap price for a new oil field. Without the imagery from the satellite the team would have needed more than 240 kilometres of seismic surveying, at a cost of around



US Geological Survey

Topological map of the Denali National Park and Preserve, Alaska, based on data from the Multispectral Scanner System aboard Landsats 3 and 5



CNES/NERC

Perspective view of part of southern Snowdonia produced by overlaying a digital model of elevation with multispectral imagery from the Spot satellite

$750 000, before anyone could reach the same interpretation.

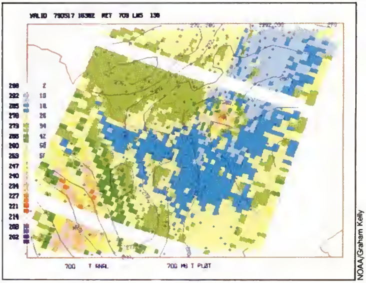
Geologists are increasingly using images from satellites to detect minerals, or the surrounding zones that the minerals alter. Minerals, individually or in combination, reflect and emit electromagnetic radiation in characteristic ways, and thus they can be classified by computer. Using this technique, geologists have discovered new exploitable copper ores in Bolivia and Colombia as well as a gold prospect at Pajingo, in Australia.

Radar imagery can discriminate between different types of rock even when they are concealed by forest. The chemical and physical differences of the rocks can cause slight differences in the texture of the forest canopy, which people trained in analysing the images can spot. Moreover, in arid regions, radar can sometimes penetrate the dry, superficial deposits and reveal the form and structure of the underlying rock.

Improved spatial resolution

Agricultural analysts mapped and monitored crops in North America by means of images from the Multispectral Scanner System aboard Landsat. When agriculturalists tried the same technique for parts of Western Europe their attempts were hampered by the fields being too small and irregularly shaped. Today, agriculturalists are able to discriminate between crops more successfully and assess changes in the use of land more accurately, through the improved spatial resolution provided by the Thematic Mapper and Spot. They can also discriminate between crops even more successfully by combining images taken when the developing crops show characteristic changes. The main limitations for the technique in Northern Europe remain the interval at which satellites pass overhead and the presence of cloud.

The use of remote sensing in these applications will never replace the need for data collected by aerial and ground surveys. Scientists find that the most effective way of using data from remote sensing is to combine them with those collected by other means. Certainly, in the future, people are likely to use remote sensing increasingly as part of a "geographical information system" (GIS). Land and resource managers, market researchers, planners and policy makers routinely collect data and manipulate them in numerical form on computers. Many of the data refer to particular regions, and the user may compare different sets of data and seek links between them. Within a GIS, remotely sensed data could be combined with digital cartographic and socio-economic data sets. Planning bodies, local authorities and central government could turn to such information when making their decisions and policies. Typical applications would include transport networks, the epidemiology of disease, use of land, and the organisation of public utilities.



NOAA/Graham Kelly

A thundery front moves across Tasmania and southwestern Australia. A false-colour image of cloud tops, recorded in the infrared by a NOAA weather satellite, is overlain with contours of tempertature measured conventionally at areas marked with crosses at 700 millibars—at about 2000 metres. The red areas are the thundery clouds. All temperatures are in degrees Kelvin

One of the central recommendations in the report *Handling Geographic Information*, produced in Britain by a committee of inquiry, chaired by Lord Chorley, and set up by the Secretary of State for the Environment, is: "A central body, independent of government, should be set up to provide a focus and forum for common interest groups in the geographic information area, undertake promotional activities and review progress and submit proposals for developing national policy. Its members should be free from all interested groups and it should maintain strong links with the government". The British National Space Centre, formed in 1985 as a focus for Britain's space effort in science and technology, now identifies the GIS as a major way forward for remote sensing.

The whole future of remote sensing depends on whether the organisations involved can handle the central problem for information technology—the dissemination of data and the provision of useful information and products. A number of problems prevent people from making wider use of satellite data. Sometimes they are hampered by the inadequecy of ground facilities for data processing. Often, the people who deal in the data fail to distribute them satisfactorily, or they fail to turn the data into products, such as maps, charts and forecasts, that are easy to handle and available for immediate use. Britain is currently committing major resources to ensure that the kind of data that users demand from ERS-1 becomes available quickly, in a format that is of immediate use. The British National Space Centre is now designing a satellite data centre, to supply information on oceans, land and ice surfaces derived from data collected by ERS-1. It remains to be seen if the new centre can cope with all the applications that will be expected of remote sensing in the lead up to the 21st century. ☐

Dr Garry Hunt is a business manager for Space Services at PA Computers and Telecommunications. The authors thank the staff of the National Remote Sensing Centre, Farnborough, and especially Jan van Smirren and Jennifer Smith, for their help in preparing this article.

FORUM

A shot in the arm for grouse moors

Grouse have reason to be grateful to the gun brigade, as Ian Mason explains

'APOTHEOSIS OF THE GROUSE'

George Tute

THE green-welly brigade will have been out in force for the "Glorious 12th" last week: the beginning of the season for grouse shooting. It will mean little to the grouse blasted out of the sky during the months to come but, in the past few years, they have been the object of more scientific scrutiny than almost any other British bird.

Gamekeepers have been keeping a close eye on grouse for more than a century. However, the most determined study of the ecology of grouse started ten years ago this month.

On a North Yorkshire moor in August 1977, low cloud thwarted the shooting ambitions of a party of moor owners. So they spent the day swapping opinions on how to manage and conserve grouse. They were worried about reports that the numbers of grouse were falling dramatically in some areas, forcing moor owners to sell their land, or turn it over to less desirable uses. They decided that research was urgently needed to find out why grouse populations were plummeting. The result of their deliberations was the North of England Grouse project, devoted to the study of red grouse.

The project quickly raised research funds of about £150 000, and recruited Peter Hudson, fresh from a postdoctoral stint studying humming birds in South America. Ten years on, Hudson feels that he has teased out some of the factors that control populations of grouse.

People have long been curious about why populations of grouse should vary so markedly. Even on a well managed estate, sportsmen might shoot 250 birds per square kilometre in one year but, in the following year, have insufficient numbers of birds to justify the bother of loading their guns. Scientists have been arguing about the cause of these population crashes for decades. On the one hand, there are those who believe that intrinsic factors, such as inbuilt behaviour, are responsible. Others believe that the blame can be laid squarely at the door of external factors, such as the availability of food or the number of predators and parasites.

Hudson himself holds a view that is both conciliatory and pragmatic. He feels that there is unlikely to be a single cause, but that the answer probably lies in a complex interaction of factors: what is true for grouse in the northeast of Scotland may not hold true for a moor in Yorkshire. However, he believes that parasitism should take pride of place in explaining the crashes in population.

In an elegant series of experiments over the past ten years, Hudson has demonstrated the importance of the parasitic worm *Trichostrongylus tenuis* in regulating populations of grouse in the North of England. He began his study by charting the population crashes on specific patches of moor. Clearly, they were extreme. For instance, in 1982, one plot gave a count of 609 grouse in late July. In 1983, the same plot of moor yielded only 15 grouse.

To get a broader picture, Hudson next examined the "bag records" of 63 English grouse moors. These bag records are scrupulously kept by moor owners. Some records go back more than a century. For Hudson, they have provided an invaluable research tool: "The records give us an opportunity rare in ecology," he says. "We can map the distribution and abundance of this one subspecies for scores of years."

The survey of bag records showed that, for 83 per cent of the moors sampled, the fluctuations in the numbers of grouse were cyclic. Most estates produced a peak in numbers every four to five years.

To Hudson, the timing of the cycle suggested that an external factor, such as a predator or parasite, was at work. Gamekeepers, sportsmen and naturalists had commented on the presence of *T. tenuis* in the guts of red grouse for more than 150 years, but no one had studied the parasite and its relation with its host in detail. Ancedotal reports suggested that the worms were more abundant in the guts of grouse in poor condition when numbers of grouse were low. Hudson decided to investigate the effects of the parasite by conducting a clinical trial.

He captured grouse hens on English moors and treated half with an anthelmintic, levamisole hydrochloride, and half with a water 'placebo'. Before releasing the hens, he fitted each one with a tiny radio transmitter, tuned to an individual frequency. (Hudson initially had difficulty getting the transmitters to remain in place. His wife suggested that a harness modelled on a "cross your heart" bra might do the trick. It worked a treat.)

By stalking the moor armed with a receiver, Hudson was able to track down the nest of the hens and count the numbers of eggs they were incubating. In subsequent visits, he noted the number of eggs hatched and the size of the brood. He checked the effect of the anthelmintic on the parasite by collecting faecal samples from radio-tagged birds and counting the number of parasite eggs in the faeces.

Comparing the parasitic burdens with the breeding success of the birds clearly

Ian Mason is a scientific writer and editor.

established that *T. tenuis* affected the number of grouse: hens treated with the anthelmintic reared significantly more young birds than those given water. Furthermore, using a mathematical model, Hudson demonstrated that the effect of the parasite was the essential element behind the four-year cycle in grouse numbers.

But if the parasites were so important, what was happening on the 17 per cent of moors where the fluctuations in the numbers of grouse did not follow a regular cycle? The answer, Hudson says, probably lies in the vulnerability of the eggs of the parasite. The eggs are shed with the faeces of the grouse. When grouse numbers fall, the parasite needs to survive on the ground long enough to be able to reinfect grouse when the population starts to increase again. However, laboratory studies have shown that the eggs of *T. tenuis* are prone to dehydration. If the droppings dry out, the eggs die. Having studied bag records, rainfall figures and levels of infection among grouse from different moors, Hudson has found that levels of infection remain low on moors where rainfall is low.

Working with a drug company, Hudson has recently devised a way of administering levamisole hydrochloride to grouse in the wild (*New Scientist*, 13 August, p 27). If the product gains approval from the Ministry of Agriculture, the birds could benefit directly from his research.

Hudson stresses that *T. tenuis* is not the sole cause of the crashes in population of grouse. Other studies have shown that factors such as the availability of insects for young grouse to eat, and tick-borne viral infections, such as louping ill, also play a role in controlling numbers.

Hudson moved his base 18 months ago. A small team remains to work on the North of England Grouse Project, monitoring the English moors and refining techniques. Hudson himself has taken his "task force" north of the border, to sort out the rapidly declining grouse populations in Scotland. Initiated with a gift of £100 000 from a benevolent sheik, the newly formed Scottish Grouse Research Project has attracted funds of more than half a million pounds. This month, Hudson will doubtless be following the guns on a Perthshire estate, collecting blood samples from grouse as part of a new project on viral infection.

Hudson is often asked: Why bother putting all this effort into research on grouse? At the end of the day, the grouse remains a game bird. Its life will almost certainly be cut short by a bellyful of hot shot.

"I don't shoot personally," he replies, "I'm in it for the science. It's a matter of conservation. We have internationally important moorland sites moulded and shaped by grouse moor interests.

"Shooting is good for grouse populations and moor management helps to conserve other species like merlins, harriers and plovers. I'm sure it makes ecological sense because, if you look at the dreadful alternatives—like mass afforestation—you are left with an environmental disaster.

"Here in Perthshire, where I am currently working, the rot has already set in. Where ten years ago there were beautiful heather-clad hills there are now forests. The moors have fallen like dominoes to the pine. It must be stopped." □

Sayonara to all that

Mike Fowler discusses the pros and cons of research in Japan

A FEW WEEKS from now, I shall be faced with the biggest culture shock of my life: by all accounts Britain is a difficult place to come back to. Two years in Tokyo have imbued memories of cricket, licensing hours, mugging, double-decker buses and the like with a hazy uncertainty. Did I *ever* live in a world like that? It seems just as unreal as Japan must have done in my former existence. So now is the time to ponder awhile: what should I look forward to, and what will I be giving up?

I'm certainly looking forward to a bit more space. Yet another "temporary" researcher moved into our office today, which makes 13 of us now, along with four computers and all the desks and cupboards. I've just worked out that we now have less than 4 square metres of space per person, which is about one third of the area of my £300-a-month apartment and about 50 times the standing room that I have on the train in the morning. (My colleagues have been looking quizzically at my calculations, but I long ago learnt the value of reverse inscrutability.)

I admit that I have a little more room up in the laboratory, but I find the rattling of chemical bottles during earthquakes a touch unnerving, not to mention the proximity of the arsenine gas in the next room. Anyway, should the Big One hit, we're all supposed to dive under our desks—not that an oversized lump of a *gaijin* (that is, a foreigner) like me will find room there.

And how about some proper weather? So that when it rains it's miserably cold, and you put on your coat. Trying that in Tokyo in the summer is like walking into a Turkish bath fully clothed. I mean, what's the use of warm rain? Even when the rain stops, the city just steams for three months. Life is so unpleasant outside: it's no wonder you find yourself perversely cheered by the coming of September and the typhoons . . .

And won't it be great to be just one of the crowd! I've no doubt that it's tough to belong to a minority group wherever you are, but, in Japan, we outsiders account for less than 1 per cent of the population. The sight of a horde of expressionless "salarymen" heading towards you from the exit of a subway station—black-haired, blue-suited and briefcase-carrying to a man—does tend to bring on feelings of paranoia. Tokyo's commuters have long known that the only way to cope with the phenomenal crush of humanity around them is to pretend that it isn't there. These peope aren't really rude: to them the pregnant woman boarding the train with nowhere to sit is simply invisible.

For all that, there are even more things I shall miss. I'll have to say *sayonara* to many friends, of course, but also, and strange as it may sound, I find it hard to imagine an easier place to live. It's difficult to convey just how safe and secure this city feels—violent crime barely exists. Not because the people are repressed or cowed, but simply because everyone seems to agree that that's the way it should be.

"Ah," I hear you say, "but surely the language is impossible." Yes, well . . . "Mastering" Japanese consists of phases. At first you think it's impossible, then it begins to occur to you that it's not so difficult. A little later you realise that it *is* impossible, then, finally, you settle down to a grudging respect: you'll never get on top of it, but it's tolerant enough to let you survive day-to-day life.

Other advantages? All the shops are expensive, so there's no need to shop around. The bars and restaurants are there when you need them—and only the wealthier tourists and businessmen are ripped off. And if you want to wend your bleary way home after the trains have stopped running, a myriad of taxis are waiting for you (except during typhoons, when there are none . . .). The punctuality of the trains would make a British commuter weep—I clearly remember the day I was annoyed because my morning train was 45 seconds late.

Working in a research lab here has been a revelation. It *is* true what they say about originality being a bit stifled under the Japanese system, but when an idea is beginning to show some promise no one sits around. The emphasis is on getting things ▸

Gamma

Singing in the rain . . . The only snag is, the raindrops are hot

▸ out into the market. The prevalent attitude is: "Perhaps things *aren't* perfect yet, but the people who can tell us best are the customers." Fifteen years ago, everyone knew that Japanese cars were cheap and nasty: nowadays, they're just cheap.

It's all too easy to sneer at Japanese research as being entirely derivative, used only to turn a fast buck. However, there are plenty of labs like my own, working on fundamental projects, with any likely payoffs a long way off. Even so, a certain part of everyone's mind is always thinking, "How can we make something with this *today*?" Most research in Japan is paid for by industry, so this attitude is hardly the heresy that it would be in Britain. I remember the anguish my old professor suffered while trying to file a patent application through a British university, the first it had had to deal with for many years. Researchers at my lab in Japan are expected to average one patent application every three months. Each. (Yes, a lot of them *are* rubbish, but the point is they're trying.)

I wouldn't advise anyone to come to Japan to make their fortune (stick to the US or the City). Nor purely to advance a career in research (not speaking the language means that the simplest tasks inevitably take longer). But if you've got that restless streak that wants to do something for the hell of it, to put off that mortgage for a while . . . well, in that case, go for it. That's why I did it. □

Mike Fowler worked for NEC in Tokyo. He is about to take up a new job in Britain.

Too hot to handle

It's not just the heat that's killing people in Athens, says John Blunden

THE DEATH toll from the heatwave in Greece makes the annual spate of road deaths among holidaymakers pale into insignificance. The final figures may not be known for some time but it seems likely that more than 1300 people died in the heatwave, with 1200 dying in Athens alone.

Many of the newspapers for which the heatwave provided headlines seemed to assume that the high temperatures alone caused the problems. Admittedly, a high of 50 °C was recorded and the temperature remained above 40 °C for more than a week. However, Athens has a particularly high density of buildings. This exaggerates the "heat island" effect observed in many cities around the world. Here, the buildings absorb and store large amounts of heat from the Sun—much more than the vegetation and soils of the rural areas. At the same time, the configuration of the buildings reduces wind speed, inhibiting ventilation.

Perhaps newspaper columnists were right to advise would-be tourists about how to survive in such temperatures. However, the deaths in Athens were not the result of temperature alone. The heatwave simply highlighted the problems of a city which, perhaps more than any other in western Europe, suffers from pollution, uncontrolled urban development, overpopulation, poor health-care facilities and bureaucratic laissez-faire.

In most cities of the developed world, land use zoning, which places restrictions on the density and siting of buildings, has become common place. So, too, have schemes for managing traffic and controlling air pollution. In Athens, in a period of rapid economic growth, such precepts have been largely ignored. All this despite the fact that, 10 years ago, the World Health Organisation produced a report on the environmental problems facing the city.

Of the deaths in the capital, nearly 900 occurred in hospitals, while other victims were found dead in their homes. Some of the victims had existing medical problems. A group of handicapped children, for example, died from dehydration, while a dozen inmates of a psychiatric home were given medicines incompatible with the high temperatures. For most of the victims, the problems of the city, and in particular the combination of air pollution and heat, will have been the main cause of death.

AP

Greek tragedy. Deaths could have been averted through better planning

Presenting his preliminary report on the catastrophe, the Greek minister of health, George Mangakis, recognised that it underlined the inherent weaknesses of the city, and that it was time to put into practice "a large land clearance programme" to create open spaces. Pollution from the rapid industrial expansion in Athens, and the proliferation of motor vehicles, has led to a serious deterioration in air quality. Yet those who have studied the urban development of the city have long known that one way of drastically reducing the impact of that pollution would be to create more green areas.

Research over the past 20 years has more than borne this out. Experiments have shown, for example, that about 1 hectare of deciduous woodland is capable of extracting 4 tonnes of dust per year from the atmosphere. Studies in Hyde Park in London have revealed that a green area of about 260 hectares reduces the concentration of smoke by more than a quarter, while a green belt 183 metres wide can reduce levels of dust by 75 per cent. Conifers are by far the most effective filters: varieties of pine which grow around the Mediterranean can reduce levels of dust in the atmosphere by 20 to 50 per cent. These figures are supported by experiments in the Soviet Union, where areas of park around factories have lowered levels of dust in the air by 40 per cent.

The effects of pollutants from motor vehicles can be mitigated by traffic management schemes, which either improve the flow or reduce the level of traffic, or by building roads away from residential areas. Similarly, the effects of industrial pollutants can be reduced by separating the sources from the zones most at risk by green spaces. In Leningrad, for example, the concentration of sulphur dioxide in the atmosphere has been found to be 50 per cent lower over parklands than in neighbouring areas which lack green spaces. The importance of green spaces has long been recognised in Chicago, where city planners have taken the further step of moving people at risk, especially children and the old, away from major roads by relocating facilities such as hospitals and playgrounds.

In Athens, the problem seems to have been not so much the lack of recognition of this work, but of the political will to act upon it. Thus, although politicians have long dreamt of demolishing parts of the city and putting in green zones, little has happened. Open spaces still only occupy 3·6 per cent of the land in the capital. With one-third of the 9 million people in Greece living in Greater Athens, population densities can reach a staggering 1600 persons per hectare. In one such district, Kallithea, the total open space is no larger than the average-sized London square.

The heatwave will pass, but the basic problems persist and worsen by the day. As businesses grow, and as a growth in vehicle ownership accompanies increased prosperity, the prospects of dissipating the famous "nefos", the cloud of pollutants which hangs above Athens like a brown shroud, seems as remote as ever. □

John Blunden is a reader in resource management at the Open University.

Put a sock on it!

Andrew Mulholland has the answer to passive smoking

READING *New Scientist* one day I came across a technique for discouraging smokers, a technique that appealed to me. The idea was to buy some cheap scent. Then, if a person near you started to smoke, all you had to do was to spray around that person with your own miasma. A brilliant idea. I had, however, one reservation. The person reported to use that technique was a woman.

The problem I forsaw was that, if I tried to use such (fully justified) retaliatory tactics, the confrontation would escalate. If I, a man, tried to pull that trick on another man, I might preserve my lungs, but I would be risking my looks. Generally, it seems to men who smoke in what are nominally non-smoking areas and, because men are less likely to agree to put out their cigarettes, it is usually men that I have trouble with.

Despite my misgivings, I was still tempted to use the method. But then I saw another item in the magazine about a new fireproof hood (*New Scientist*, 29 January, p 39). Immediately, I was struck by a (blindingly obvious) idea. The hood is designed to keep out hot, poisonous fumes. It has a pad in one side, which is permeable to air, but not to noxious gases. It is made from a polyamide material, just 25 micrometres thick, so it will fold very small for storage.

I do not know what one of these hoods would cost, but, if they were made in sufficient quantities, I am sure that they could sell for less than £1. The perfect answer, I thought. Have you ever noticed how there are never any seats in the non-smoking carriages of trains, and that the bottom (no smoking) deck of a bus is always the first to fill up? Now if there are no seats in the non-smoking carriages, or if the bus conductor shouts "No standing, please", all you need to do is pop one of these bags over your head and brave the cancerous fumes. The bag could be carried in a purse or a breast pocket—a sort of high-tech handkerchief (though not particularly suitable for blowing your nose on).

It was only more recently that a second idea struck me. It seems a bit much that, merely in order to breathe cleanish air, a non-smoker should have to go to so much trouble. After all, it is not the non-smoker who produces the noxious fumes.

I propose, therefore, that smokers should be allowed to light up wherever they want. Anything less would be a restriction on their civil liberties. The only requirement will be that they will have to wear a FagBag. This devise will be exactly the same as the bags designed to keep smoke out. It will simply be turned inside out.

The idea is not so impractical as it sounds. I admit that, initially, there may be a certain amount of consumer resistance to the idea. However, there are a number of advantages in this scheme which would make it very welcome to smokers and, indeed, to the tobacco companies.

WE SEND IN A BATTALION OF HEAVY SMOKERS.
CHEMICAL WARFARE PLAN

First, there would no longer be the social problem of whether or not to smoke after a meal. Most smokers like to relax with a cigarette after dinner; most non-smokers would rather they did not. Simply by popping one of these bags over their heads, smokers would be able to avoid a potentially embarrassing situation yet puff away to their hearts' content. In fact, they would be welcomed back into society. Freed from their ghettos, the "no smoking" signs torn down, smokers would be allowed to rejoin the human race.

Why should the tobacco industry welcome this innovation? Well, the fact that people will be able to smoke without upsetting others will mean that the pressure to give up will lessen. Non-smokers may shake their heads sadly, but their fists will remain by their sides.

In addition, the bag will catch all the products of a cigarette: none of them will be lost to the atmosphere. This will lead to a radical rethink in the design of cigarettes, and also the way they are smoked. No longer will it be necessary to chew on a fag and suck in the smoke through the mouth. Instead, people will be able to smoke cigarettes through their noses. This will allow a rapid intake of nicotine while eliminating that disgusting affliction "ash tray mouth". The nicotine-stained teeth and bad breath that has dogged smokers for years will become but a hazy memory.

So far, I have touched only on the advantages of the FagBag. The one disadvantage I can see, and this would apply only to young people who smoke in secret, is that would increase the chance of being found out. "Jane, I was tidying your bedroom today and I found this under your packet of condoms and your AIDS leaflet. Don't tell me it's what I think it is. Don't tell me it's a FagBag!" ☐

Andrew Mulholland is studying mathematics at the University of Cambridge.

Foreign interests, Zircon and space

More comment from Westminster

THISTLE DIARY

Tam Dalyell MP

IN THE days of the indirectly elected European Parliament, I was a member of the Energy Committee. I am interested, therefore, in the second report on Europe's response to the modern technological challenge, drawn up under the chairmanship of Michel Poniatowski. Among other things, the report claims that Europe must now face up squarely to the question of how public authorities are supporting the exploitation of research: "The Eureka endeavour will not succeed unless in the end there is some public support for harassing technologies to specific product goals, for example supercomputers or voice-activated computer terminals."

Rhetorically, the committee responsible for the report asks why the six or seven major European firms responsible for information technology can't pool their resources to develop a European supercomputer. I must tell them why—and forgive me for putting it in personal terms.

A thousand of my constituents earn their living at Hewlett Packard, and HP, an American corporation, is already on the point of marketing "Office Talk", a combination of personal computers, applied software, entry and exit cards, systems for telephone management, an electronic diary, and vocal messenger services. Similarly, earlier this month, I attended a sod-cutting ceremony on the site of the late Marquis of Linlithgow's polo ground, overlooking the Forth: this is to be the home in Britain of the American Digital Equipment Corporation, which will employ 400 of my constituents.

The same kind of story can be repeated throughout Britain, and in Europe. I also represent some hundreds of constituents who earn their living from NEC, whose headquarters are in Osaka. Japanese firms spawn throughout Europe. Twenty years ago, some of us were championing the idea of a European Technological Community. It's now too late. And Poniatowski's worthy report is alas, no longer worth the paper it is written on. That said, I remain pro-Communitaire.

* * *

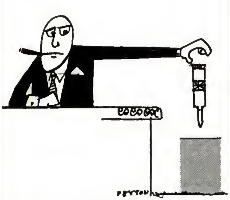
IF YOU have wasted more than £70 million of taxpayers' money on a satellite such as Zircon, whose technology has been overtaken; if you have found a place to store nuclear waste; in fact, if you have any decision that is likely to cause a rumpus, wait until the first week in August and then announce it. That way, MPs, journalists and other troublesome folk might have their minds on other things.

What the people involved with Save British Science must conclude when they contemplate the money squandered on Zircon, I shudder to think. The announcement that Chapelcross in Dumfriesshire is likely to be chosen as the site of a dry store for irradiated fuel (*New Scientist*, 6 August, p 21) came at an equally fortuitous time.

First, I would like to know what reprocessing is to be done at Chapelcross. ▸

▸ Secondly, I gather that one major consideration that tilted the balance in favour of Chapelcross, if this is how the people of Dumfriesshire see it, was transport. Greenpeace and other organisations have expressed concern about the transport of spent fuel rods. For my part, I have always believed that transport was a more substantial problem than storage.

* * *



IN ALL the hooh-hah about the government's refusal to finance increased activity at the British National Space Centre, the last sentence of Margaret Thatcher's now celebrated reply to Michael Marshall MP on 23 July has been swamped. "I hope that the private sector, if interested in the results from such research, will come forward with considerable resources."

I understand that the private sector has shown no indication of so doing, partly because there is no easy mechanism whereby such investment can be made. Who other than government can coordinate such activity? I have set down a parliamentary question to the Prime Minister for October, asking her for an estimate of the "considerable resources" she hopes for.

* * *

FORGIVE a Scot for thinking this month that the senior Law Officer in Scotland, Lord Cameron of Lochbroom, was a good deal wiser than the Attorney General in finding reasons why he should not get involved in prosecuting newspapers about secrets. The Scots may also be wiser on another legal matter: hacking. Gaining unauthorised access to computerised data banks to inspect or alter information should be a criminal offence, according to the Scottish Law Commission. The Commission, in its Report on Computer Crime (Scots Law Commission, No 106, HMSO, £5) also recommends making it a crime for people to corrupt or to erase programmes or data, even unintentionally, after gaining unauthorised access to computers.

Hackers are not at present committing an offence in Scotland. The position in England appeared to be different after the successful prosecution of two hackers who had gained access to the Prestel computer network under the Forgery and Counterfeiting Act 1981. But the convictions were overturned by the Court of Appeal, which decided that dishonestly gaining access to a data bank by a trick was not a criminal offence. As it stands, the law is deeply unsatisfactory in both England and Scotland and should be up-dated. ☐

FEEDBACK

WILY SCOTS this week unveiled a scheme to build a replica of the leaning tower of Pisa—ten times taller than the original. The 545-metre structure is planned for a site in Sutherland, in the far north of Scotland.

This bizarre proposal—yes, it's a hoax—is the latest salvo from anti-nuclear campaigners fighting the plan to locate the world's largest fast-reactor reprocessing plant at Dounreay, in neighbouring Caithness. A formal application for the tower, known officially as the European Demonstration Reclining Tower, was lodged with the planning authority on Tuesday.

This wheeze is the brainchild of the Campaign Against Dounreay Expansion. The acronym of the tower, EDRT, is uncannily close to that of the reprocessing plant, EDRP.

The protesters hope that their plan for the tower will highlight criticism of the way the scheme for the reprocessing plant has been handled: "If it can be granted outline planning permission on the basis of sketchy plans, no transport or waste disposal or safety analysis then our reclining tower should easily get permission." ☐

EVERY ONE seems to be having a go at British Telecom at the moment. The National Consumer Council, for example, recently suggested that the company provided one of the least popular services in Britain. Similarly, *The Spectator* magazine is running a competition for anecdotes that show the company in the worst possible light.

We have horror stories of our own, of course. Only last week, for example, we tried to report a faulty line. We tried the telephone engineer on 151. The message back was that we should phone 829 4463, which put us on to 829 3131, which put us on to 829 4292, which put us on to 829 8954, which put us on to the customer services engineer. He told us to try 151. Just as we were about to explain that we'd already tried that, we were interrupted by a voice saying "Orry lines are busy . . . Sorry, lines are busy . . ."

Nevertheless, it all seems a bit unfair. In the interests of balance, we've decided to run a competition of our own. We hearby announce our "Say something nice about British Telecom competition", in which the best anecdotes will be rewarded with the usual tenner. Employees of British Telecom will be excluded from the competition, and any one entering it is asked to provide a signed statement to the effect that they do not own BT shares. ☐

MIND YOU, if British Telecom wants to improve its image, it could always take a leaf out of the book of the Post Office. A friend of Feedback's recently complained to the Post Office that it had taken four days for some "First Class" mail to travel 25 kilometres from her home in Oxford. Her mother had lodged a similar complaint about a letter that had taken a tortuous route to reach her address in Cumbria. The Post Office, it seems, has been quick to respond. The daughter in Oxfordshire has just received a letter from her mother in Cumbria, franked with the date for the day *after* it arrived. ☐

WE HESITATE to say this, but we may finally have the answer to the question of why a computer company should call itself Apple (Feedback, 30 July, p 63). Derek Rowe, an electronics engineer in London, rings to tell us that it's all his fault.

Rowe claims to be an old friend of Steve Wozniak, one of the founders of Apple. Some years ago, apparently, when Wozniak was still working on his prototype computer in the US, and before he had started his company, Rowe was working for the Apple recording studios in London—the studio founded by the Beatles. One year, knowing that, like most Americans, Wozniak was enthralled by the Beatles, Rowe sent him a Christmas card showing John Lennon, together with two sheets of Apple notepaper. Wozniak, it seems, was delighted. "It's all very mundane," Rowe says, "but that's where the inspiration came from." ☐

ENIGMA

No 424

A round of fractions

by Keith Austin

ANNE and Barbara have just played a round of golf consisting of 18 holes. Anne decided to keep an unusual record of the game. After each hole she formed the fraction consisting of her total score to that point divided by Barbara's. Naturally she reduced each fraction to its lowest terms. For example, if, after seven holes. Anne had had a total score of 33 strokes and Barbara one of 30 strokes, then Anne would have recorded the fraction 11/10. The fractions Anne obtained are as follows, in increasing order, not necessarily in the order they occurred in the game:

9/10, 25/27, 14/15, 17/18, 18/19, 19/20, 29/30, 31/32, 1, 68/67, 36/35, 28/27, 12/11, 7/6, 9/7, 7/5, 3/2, 5/3.

On the course that Anne and Barbara played on, each hole was par 4. that is, at each hole a player is expected to take four strokes. In their round, each girl, at each hole, scored par or a birdie or a bogey. A birdie is a score one less than par and a bogey is a score one more than par.

Which holes did Anne win, that is, take fewer strokes at, which did Barbara win, and which were shared?

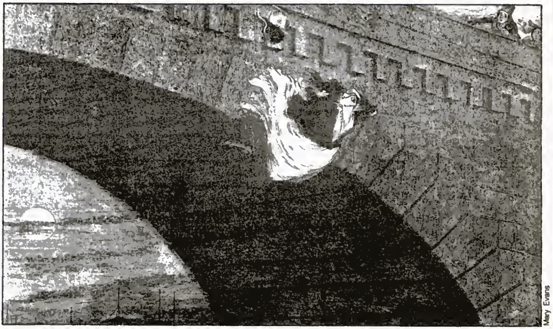
A £10 book token will be awarded to the sender of the first correct solution opened on Thursday, 3 September 1987. Please send entries to Enigma No 424, New Scientist, Commonwealth House, 1-19 New Oxford Street, London WC1A 1NG. The Editor's decision is final. The winner of Enigma No 421, "Simple arithmetic", was Bill Martin, of Lindfield, Sussex.

Answer to Enigma 421

Simple arithmetic

$$\begin{array}{r} 79422 \\ +\ 3104 \\ \hline 82526 \end{array}$$

Probing the psychology of despair



Mary Evans

Suicide in Victorian and Edwardian England
by Olive Anderson, *Oxford UP, pp 475, £40*

David Cohen

IF AN insider trader killed himself after being found out, I think most people would be surprised. Yet if a Roman or Victorian stockbroker had been caught so dishonoured, he would have no alternative but either to open his veins or blow his brains out. At least, that's what we think now. Certainly, it is interesting to compare the reaction to the Wall Street crash in 1929, when the American government became worried by the epidemic of stockbroker suicide, with behaviour now. In her erudite and often entertaining book, Olive Anderson does not, alas, compare attitudes across such large slices of history. Yet one of the most interesting aspects of suicide is how reasons for it appear to have changed.

Anderson suggests that, in Victorian London, unemployment often led to suicide. A Southwark man was sacked, thought he could not get a new job, wished his friends "Merry Christmas" and did away with himself. James Mason, a 45-year-old Victorian valet, had, perhaps, more complex reasons for suicide. He had been drinking and his employer sacked him. His employer gave him an annuity to tide Mason over but the boozing butler would have to go. A few days before he was to leave the house, Mason hung himself. Anderson argues it was not the loss of income that drove Mason to it but the fact that he would lose his identity, if he lost his job. He had been working for 20 years. Who was he, if not a valet? And, alas, he did not have access to the services of Jeeves to rescue him from the soup of despond.

These two cases illustrate some of the problems in the book. Anderson is trying to explain, from mere newspaper accounts and witnesses' notes, why people killed themselves. A hundred and fifty years on, even with more sophisticated data, psychiatrists and sociologists are still far from understanding why some people turn to suicide while others, in as bad situations, do not. Emile Durkheim, the French sociologist, would have been disappointed.

Anderson is skilful at explaining the predecessors of Durkheim, whose aim, when he published his classic study of suicide in 1900, was to show that the social sciences were as exact as the natural ones. His fellow sociologist Gustave Le Bon believed you could write equations for the behaviour of crowds. Then you could predict when a crowd might go berserk, as accurately as you could foresee when nitrogen monoxide would turn to nitrogen dioxide. We know better these days than to have such high expectations of natural sciences.

How far have we advanced? From the 1840s, commentators were struck by the stability of the statistics for suicide as these started to be collected properly. If, every year, a similar number of people did away with themselves, perhaps the causes were not just individual despair or misery. Something more social lay at the root of it because, otherwise, there would be more extreme fluctuations.

Anderson does a thorough job on four areas of what we have come to know as "suicidology". She examines the way in which statistics of suicide were gathered. Her account of how London and some rural areas in Britain developed coroners courts is fascinating. In London, the coroners became more professional from 1830 on. They took note of medical evidence and refused, increasingly, to hold inquests in pubs. In the countryside, the procedure was more casual and certain forms of death, especially when young ladies drowned themselves, were glossed over. Suicide carried then, as today, considerable stigma. Nicer for your loved one to have died by accident.

Statistics, Anderson argues, have always been imperfect. But enough data exists to make it clear that there were great differences in the prevalence of suicide between different parts of the country. London always attracted a slightly unsettled population, who were more likely to kill themselves. The risk of suicide was always great close to the railway termini.

Anderson also examines the experience of suicide. Here, though she has delved deeply in newspaper accounts and notes of evidence given by witnesses, she is constrained by the nature of the data. Who would today rely on the *Sun* or *Daily Express* for a completely accurate account of what anybody felt? At best, such accounts give an insight into what were current acceptable explanations for suicide. Anderson seems, perhaps, a shade too ready—maybe not surprising as she is a historian—to accept as true psychologically the self-reporting in suicide letters or a journalist's account of the Mason case. Often, suicide notes are written to create guilt.

The other two areas that Anderson examines are the nature of attitudes to suicide and the way in which doctors attempted to deal with it. Anderson's detailed historical account both of how statistics of suicide were arrived at and of some of the experiences that people recorded is valuable, but she has curiously little to say about the explanations theories they offer.

Anderson did not set out to write a history of suicide from Victorian times to the present so it is unfair to criticise her for not contrasting the situation then and now. What is perhaps most telling is how suicide still baffles sociology, psychology and psychiatry. Predicting who will attempt suicide remains very hard, as does identifying, among those who attempt it, who is most likely to succeed. In suicidology, success is bizarre; only the dead get there. Researchers still disagree about the statistics, only now the reporting of suicide has less to do with stigma and more to do with not prejudicing the insurance situation of the bereaved. And academic wrangles still continue about whether the Samaritans prevent suicide, showing just how optimistic Durkheim and Le Bon were when they equated social and natural sciences. The merit of Anderson's detailed study is that it not only gives insight into these past quarrels but makes it all too easy to compare them with present ones. □

Ova overview

Egg: Nature's Miracle of Packaging
by Robert Burton, *Collins, pp 158, £9·95*

Charles Deeming

ROBERT BURTON has certainly produced an eye-catching book. The front cover of the sleeve is emblazoned with "EGG" in bold, white-on-black lettering, and the multiple-exposure photograph of a guillemot egg adds to the effect. Closer inspection of the contents reveals a host of attractive, well-reproduced, photographs, together with a clear text printed on good quality paper.

My initial impression was that this book was about birds' eggs, but, on reading the text, it soon becomes apparent that it is actually a thorough examination of reproductive biology of many types of animal. Burton describes in detail the eggs and breeding behaviour of many insects, other invertebrates and the main types of vertebrates. In 10 chapters, he covers the natural history of the egg, which he defines in the introduction as "the reproductive unit, produced by the female, which develops into a new individual". Considering this definition, and the text of Burton's book, I feel that ovum would be a better term to use.

Burton starts by describing asexual and sexual reproduction, then the formation of the egg, and the wide variety of eggs. He also deals with the processes of copulation, fertilisation, and all the various reproductive strategies used by different groups of animals, including oviposition, nest location and building, and clutch size. Burton should be congratulated for presenting the complex processes of the development of amphibian and avian embryos in such a clear way. He also takes a look at hatching process in birds, and the role of the parent in incubation and rearing the hatchlings. The book ends with descriptions of the various types of live birth.

A moorhen may lay some of her eggs in the nests of other moorhens as insurance against her own nest being destroyed

Burton has written a very good book about the natural history of ova but, as a specialist, I was confused by the title of some of the chapters which do not complement the topic of the text. I feel that Burton planned to write a book about eggs, typified by bird eggs, and decided on titles for each chapter beforehand. It seems a pity, that, in some cases, the chapter headings give the impression that the book is a somewhat superficial analysis when this is certainly not the case.

There are 245 superb photographs. The photographs showing the pattern of development in the slug, fish and amphibian egg are worthy of special note. The captions are useful as they both complement and supplement the text. Unfortunately, one photograph of a gosling close to hatching is obviously a composite of two photographs but it is described as being natural. It is a shame that Burton felt that this should have been included.

Otherwise, the standard of the photographs by Jane Burton and Kim Taylor, supplemented by the author and from photographics agencies, is excellent. The publishers deserve praise because only six photographs are printed across two pages.

Egg is a very good book and I would highly recommend this book to anyone who is interested in embryology in particular, natural history in general, or even just nature photography. I do feel, however, that it is worthy of more than simply gracing a coffee table. To do it justice, the highly informative text needs to be read. ☐

Nuclear nausea

Einstein's Monsters
by Martin Amis, *Jonathan Cape, pp 127, £5·95*

Roderick Robinson

MARTIN AMIS, a sentimentalist? Imagine, rather, Ian Paisley on a package trip to Lourdes, or the Queen buying advertising space on Eric Bristow's shirt.

Amis normally specialises in bile, toxically enhanced with a colloquial delivery that was pioneered by his dad. Having chronicled the behaviour of demented dwarfs and pustular media folk, he was recently asked if he agreed that most of his characters were shits. Yes, he did agree. In this latest fictional work—a polemical essay followed by five related short stories—Amis has made a couple of changes.

One story features a sort of Zorba the Pole, muscular and lovable guardian of all innocents in West London and a man prepared to stand in as a car jack while the narrator changes a punctured tyre. In another, there are astoundingly precise echoes of that TV commercial in which a Labrador pup publicises lavatory paper. Admittedly, conversion to the greetings card industry is not complete and elsewhere the Amis imagination is still at work towards black ends. But one is mildly surprised.

However, what differentiates *Einstein's Monsters* from, for example, *Dead Babies* is a recognition—at first subconscious, latterly overt—of the *Bomb.* Amis was only four days old when the Soviets first tested a weapon and nuclear deterrence was born. Now he realises he has been writing about nuclear weapons ("biblical in their anger") all along. Recently, he ceased being merely a child of our time and became a parent as well. That, and other influences (he mentions his debt to Jonathan Schell's *The Fate of the Earth*), encouraged him to tackle a subject which he admits has the power to induce in him clinical nausea.

The initial essay, reprinted a few weeks ago in one of the Sunday heavies, is both passionate and laconic; it's also punctuated with worthwhile digressions. Why, asks Amis, have the senior generation of writers not been tempted by the nuclear theme? Perhaps because "art raises the stakes, increasing the store of what might be lost". Beyond that, Amis gives the bombers and their literary supporters a very hard time indeed.

The Zorba story, surprisingly, has an upbeat ending. Two deaths, seemingly inevitable, do not occur. The executioner stays his hand, believing that there must be more matter in the Universe than we think. Revenge is a non-starter. A hopeful view, at odds with the dread equivalence of Bombs in the East and in the West.

In "The little puppy that could", Andromeda, child resident of a post-holocaust village terrorised by a huge mutant dog ("carcinogenic teeth, the tumour of the tongue, the flamelets of sizzling drool") swims against the tide by befriending and bringing home a puppy. Puppyish behaviour, endlessly well-observed, it must be said, jostles uneasily with that of the Hideous Hound. Despite a spendidly volcanic climax, the extremes are ultimately immiscible.

There's a feuilleton on immortality that could have slipped out of the ingenious pages of *Astounding*, the old science fiction magazine, and two less vigorously propelled pieces which hang fire through a deficiency of Amis's more normal sardonic relish.

Believing that nuclear weapons—more particularly, their aftermath—resist a frontal assault from a writer, Amis snipes away and occasionally tosses in a mortar shell. Conventional weapons, well used. With *Einstein's Monsters*, he widens his scope by exploring the unthinkable and admitting vulnerability. Let's hope for more extended explorations in a novel. ☐

Wheelerdealing

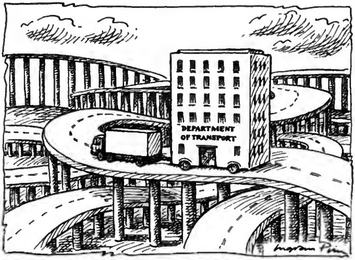
Wheels Within Wheels
by Mick Hamer, *Routledge and Kegan Paul, pp 162, £5·95pbk*

Susan Hoyle

AS AN explanation of human and institutional motives, the desire for a quiet life has much to commend it. Pressure groups are there to make sure that, at least, some people don't get away with it.

Among institutions, the Department of Transport (DT) stands out for the remarkably quiet life it enjoys. Bus deregulation and the Channel Tunnel legislation caused some furore in remoter corners of the dovecote but, in the main, transport issues rarely involve high politics. Most secretaries of state are scarcely in post long enough to discover what TSG and COBA mean, before they move on to greatness or out to pasture. Civil servants can get on with their work—a quiet life and road-building—with minimum attention from ministers, parliament or the media. It is a bit of a backwater, really. Even the relationship with the road lobby is cosy to the point that the DT regards it as a client rather than as the rather-more-then-usually-agressive pressure group that it really is.

Not that there is anything wrong with pressure groups pressuring. It's not a stone I could cast first, in any case. What is wrong is the result of the pressuring, and the reasons for its success. Mick Hamer's exposé *Wheels Within Wheels: A Study of the Road Lobby* tells the story of the road lobby's dreams and how, with ominous intent, they came true: the motorway system, the 38-tonne lorry (and the weights are rising), higher speed limits, the abysmal record on traffic restraint. It tells how keen, nay happy, the DT has been to accommodate the road lobby's ambitions. It also tells how at times, despite its best efforts, the DT simply could not oblige: the "Bulldozing London" chapter, for example, chronicles the lowest ebb of the road lobby since the war, when it succeeded only in getting the M25, one of the world's more expensive traffic jams at £1 billion, instead of the three concentric ring roads it wanted. Increased lorry weights have always been politically difficult to deliver.



Ingram Pinn

On the whole, this is one big successful lobby group. People who know the relationship which the National Farmers Union has with the Ministry of Agriculture, Fisheries and Food might think that was the ultimate partnership. I would ask them to consider that the DT owns the trunk-road and motorway network and that its staff are to a great extent employed to plan, design, politically manoeuvre for, and manage that network. The department is also judge and jury in its own cause with the inquiries into those plans. Hamer sets out this essentially corrupt system, which perhaps more than anything else, even the desire for a quiet life, explains the poverty of transport policy in Britain. And their friends inside the road lobby (I say "friends" advisedly—see Hamer's account of where some top civil servants from the DT go when they retire) consist not only of those who build and use the roads, or make the vehicles which go on them. Do not underestimate the power of those who paint lines on roads, or who sell us petrol or diesel, or who claim to represent the views of motorists.

Hamer has given us a meticulous account of what the road lobby has been up to for the last half century and more, and an invaluable guide it is. If I have a criticism, it is that a more avowedly historical perspective would have added more irony to his tale. For, in its early days, the road lobby was the underdog; one of its greatest allies was the cyclist, and the wicked lobby was definitely the railways, whose political influence matched anything the road lobby can summon up today. All that has changed now, of course but, lately, there are signs of significant cracks in the road lobby's once-monolithic front. The interurban motorway network is virtually complete and the British Road Federation's plans for London are looking a little unlikely, so those who can fry other fish are slipping off to fry them. Some notable giants of the lobby are quite keen on light-rail transit trams, for example, which is making a belated comeback to these shores.

I am glad to see *Wheels Within Wheels* back in print. The first edition, a substantially different work from this new version, was privately published and has been very hard to lay hands on for many years. The growing band of transport compaigners throughout the land will, if they have the sense I think they do, be rushing to get hold of the 1987 version. ☐

The biological time bomb

Extinction
by Steven Stanley, *W. H. Freeman, pp 242, £15·95*

John Gribbin

WILD speculation about the "death of the dinosaurs" has been rife even in the pages of respectable scientific journals in the past few years ever since traces of iridium were discovered in sediments marking the boundary between the Cretaceous and Tertiary Periods of geological time. Iridium is rare in the surface layers of the Earth, although it is thought to be present in the deep interior, and it is also known to occur in at least some meteorites. Could iridium have been spread worldwide in a pall of dust from some great disaster, so blocking out the Sun and bringing environmental destruction?

Perhaps a giant meteorite struck the Earth 65 million years ago and wiped out the dinosaurs, along with many other species around at the time. Perhaps the agent of destruction was a huge comet. Or perhaps (the reasonable variation) all that was needed was a series of huge volcanic eruptions that spewed into the atmosphere iridium-laden dust from inside the Earth. Or perhaps (the having-your-cake-and-eating-it variation) such a major eruption of worldwide vulcanism was itself triggered by the impact of a giant meteorite.

No doubt miffed at the encroachment of geologists onto their territory, the astronomers quickly got into the act. Some fairly simple statistical analysis of the changing pattern of life on Earth showed that not only had such extinctions occurred before, but that there was a hint that extinctions were cyclic, occurring roughly every 30 million years. Cycles are meat and drink to astronomers. Could these be linked to the influence of a "death star" or "Planet X", orbiting the Solar System far out from the Sun, and periodically disturbing the Oort cloud of comets to send doom crashing Earthwards?

With theorists running wildly in all directions, there has been a crying need for an authoritative but accessible book about the palaeobiology of extinctions; one which could put these ideas in context against the solid framework of present understanding of the geophysical changes of the past few hundred million years. Steven Stanley's *Extinction* is just that book.

Stanley is a member of Johns Hopkins University and a Research Associate at the Smithsonian Institution. He knows his stuff, and he knows how to put it across. His book is the latest in the rapidly expanding "Scientific American Library" series, and has the visual appeal and clarity that goes with that lineage. And although Stanley's conclusion is that no outside agency is needed to explain the several mass extinctions of life on Earth that have occurred in the past 650 million years—environmental changes associated with the shifting continents, and climatic changes in particular, are enough to do the job—the story he tells is dramatic and exciting enough to please all except the most bloodthirsty devotees of nemesis from heaven.

The "death of the dinosaurs" was not even the most dramatic of these extinctions. An even ▶

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Inquire within on everything

Encyclopaedia Galactica
An exhibition at the Armagh Planetarium, College Hill, Armagh

Nigel Henbest

In surroundings where Dr Who would feel at home, children can interrogate computers about the wonders of the Universe

THIRTY years ago, the very word "planetarium" represented a passport to an Aladdin's cave, where a glittering panoply of stars paraded over a dark vault, and the speeded-up planets played tag among the heavens.

In the 1980s, however, television, video and home micros have taken over. Now that the key words are "action", "excitement" and "involvement", the visiting public finds the traditional planetarium a rather tame affair. In response to this pressure, too many planetariums around the world have sold out. While keeping a rudimentary star show for schools and the remaining (loss-making) public performances, they make their money by using the big dome as a super-wide screen—for "360-degree" films and, especially, for laser shows.

Ironically, interest in astronomy itself has not diminished during this period—as shown, for example, by the number of people who stood outside in sub-zero temperatures to see the faint blob of Halley's Comet or stayed up till the small hours to watch the pictures from Giotto.

Planetariums have been surprisingly reticent, or perhaps unimaginative, when it has come to using the new technology to put astronomy across. The one notable exception is the Armagh Planetarium. This planetarium has an international reputation. Indeed, its director has just become the first British president of the International Planetarium Association. Ironically, it is comparatively unknown to British people living outside Northern Ireland.

Armagh Planetarium already has a number of "firsts" under its belt, including the first use of video projectors in a planetarium. This year it has chalked up two further achievements.

The *Encyclopaedia Galactica* stands in the exhibition area, adjacent to the planetarium dome. It's a place where Dr Who would feel at home. In the blacked-out corner, all that is visible is a cobweb of metal struts that support computer keyboards and TV screens—and a crowd of children fighting over the keyboards. The first thing that strikes you about the *Encyclopaedia Galactica* is that it is certainly compulsive.

First, choose your terminal. Twelve keyboards cover nine different topics, ranging from constellations and planets to spaceflight and the shuttle. Then select an item from the menu: the constellation Orion, perhaps, or sputnik. And you'll be treated to a display that is either a short video sequence, or a series of stills. At the end, you have a choice. You can repeat the sequence, return to the main menu or select a related subject from the short menu displayed.

The Pioneer MSX computers are all autonomous, and each is linked to its own Pioneer laser-disc machine. The Armagh Planetarium claims that the exhibit incorporates the largest use of computer and laser-disc technology in Britain. The material comes from a variety of sources. Much is from a Videovision astronomy disc, commercially available in the US, some from the ITV Spacewatch programme and some from a video tape, the "Graphic guide to the heavens", made by the Armagh Planetarium. All is fascinating viewing.

So, is it an encyclopaedia? My feeling is that it isn't. An encyclopaedia may or may not entertain, but its main function is to impart information on topics selected by the user. The Armagh version is weak on information. Select Jupiter's moons, for example, and you'll find a wealth of colourful Voyager pictures but precious little information. For an educational exhibit, I'd also take exception to such masterpieces of spelling as "quarentine", "space taxies" and "shepard moons".

As a taster to get children more interested, however, it is difficult to fault this exhibit. There's certainly enough material to provide hours of entertainment for the kids and for the adults who manage to get a look in!

Up in the planetarium itself, another innovation is taking shape: a hands-on planetarium show. After installing the original innovatory pair of video projectors, the planetarium's director, Terence Murtagh, has increased the number to five: they project four images around the dome, and one overhead. Murtagh pulled off another coup last year when he projected images from Giotto *live* onto the planetarium dome.

Now, Murtagh is installing a system that will allow the audience to control the show. Each seat is equipped with a handset, which has three illuminated buttons. The planetarium lecturer projects a multiple-choice question on the dome, and members of the audience press the appropriate button. A histogram of the answers builds up on the dome.

For a schools' show, this is a magic way of involving the children and keeping their attention. "How many planets are there in the Solar System: 9;7;11?"—and if a substantial proportion get it wrong, the lecturer can explain what the right answer is, and why.

The potential for public shows goes further. The first will involve a guided tour of the Solar System. Above our heads, the planetarium "sky" becomes the observation dome on our spaceship, complete with a head-up display of where we are and our possible destinations. Would the audience like a visit to Mars; or perhaps a trip to the warmer climate of Venus or Mercury? The choice is ours, and the majority verdict wins.

A Pioneer MSX computer and laser disc once again accomplish the miracle. The disc contains sequences for all possible outcomes of each question, and the computer picks out the sequence that corresponds to the audience's decision. It's a case where the disc wins over videotape, because the machine can gain access to sequences on a disc almost instantaneously.

With these two new innovations, the Armagh Planetarium has kept up the reputation it has won in recent years, of being second to none in the world. It has also proved that planetariums can have a viable future—in astronomy. ☐

► more devastating event brought an end to the Palaeozoic era, 250 million years ago, and at least a dozen other significant extinctions occurred in the time span under consideration (though there is no real evidence of a repeating cycle). Stanley relates each of these to the geography of the globe at the time—colliding continents, the shifting balance between shallow seas, deep ocean and land, and the ever changing climate.

He is smack up to date scientifically—for example, with Robert Bakker's compelling re-interpretation of the evidence to show that dinosaurs were hot-blooded, active animals—and provides the best overview of the changing relationship between the physical environment and life that I know of. He has produced an enthralling book, and if the only concrete product of all the debate about extraterrestrial causes of mass extinctions of life on Earth is to have prodded Stanley into producing this rebuttal of those claims, then all the hot air has not been expended in vain.

It was Carl Sagan who once said that "science is far more exciting than science fiction, far more intricate, far more subtle—and science has the additional virtue of being true." It was books like this that he had in mind. ☐

This week's reviewers

David Cohen is a television producer and editor of *Psychology News*. He is author of *The Development of Play*.

Charles Deeming is in the department of pure and applied zoology at the University of Reading.

Susan Hoyle is executive director of Transport 2000, the British environmental transport campaign.

Roderick Robinson is editor of *Materials Handling News*. As well as books, he reviews restaurants!

LETTERS

Gene banks

Traditional varieties of crop plants, including vegetables, have sustained mankind since the dawn of agriculture over 10 000 years ago. These varieties of plants, sometimes referred to as "landraces", are becoming extinct as farmers prefer new hybrids which, although higher yielding, require high inputs of fertiliser and pesticides.

Today's plant breeders rely on traditional crops and their wild progenitors for genetic material to improve their own genetic breeding stocks. The former are presently conserved in what are known as "genebanks" which preserve seeds and other forms of propagules from all over the world on a long-term basis at sub-zero temperatures.

One such genebank for vegetables is located at the National Vegetable Research Station in Wellesbourne, Warwickshire. The facility was constructed and its maintenance guaranteed for five years or so by funds from Oxfam. The period has now expired and the Science and Engineering Research Council, which was supposed to support it from then on, is now hesitant in the wake of the present policy to auction off plant-breeding research to private interests.

It will be a pity if such a storehouse of genetic resources, painstakingly assembled, were to pass into private hands which would then, undoubtedly, utilise them for gain, foisting newly developed cultivars on farmers with limited means.

One has only to recollect the great famine in Europe caused by *Phytopthora infestans* blight for which the crop had no resistance. Another example was the famine in Bengal in 1942 when the rice crop failed, resulting in thousands of people starving to death. Even developed countries have not been immune to crop failures in recent years due to newly evolving pathogens, as was seen during 1970/71 in the United States when 30 per cent of the maize crop was devastated by *Helminthosporium maydis*, to which the crop had no resistance due to its uniform genetic composition. Traditional forms are highly variable: susceptible and resistant genotypes exist side by side.

Ardeshire B. Damania
ICARDA
Aleppo
Syria

Synthetic bones

Claus Dechau reported on new work on the use of a natural precursor to make "synthetic bones" (16 July, p 38). Apparently he was unaware of the report in *New Scientist* that precisely this approach, using sea-urchin spines and corals, was done 10 years ago (21 October 1976, p 163).

These materials are unique composites. Corals were selected which mimic human bone most closely are covered by US Patent 3 929 971. They were reacted hydrothermally to make the first strong, porous hydroxyapatite ceramic. Commercial biomaterials are being sold by Interpore International in California. Since then other workers have made sintered apatites but they cannot easily attain the required connectivity.

Della M. Roy
Materials Research Laboratory
The Pennsylvania State University

Super air

In the article "Do-it-yourself superconductors", Paul Grant suggests using a flow of oxygen to improve the electrical properties of the superconductor he describes (30 July, p 36). I have found that the required result—a superconductor with a high critical temperature—can be obtained by replacing the oxygen cylinder with an air pump used for fish tanks such as those available from the biology department in most schools. The advantages are obvious; no heavy cylinders to move around and an inexhaustible supply of air.

Les Kirkup
Paisley College of Technology
Paisley
Renfrewshire

* * *

The article "Do-it-yourself superconductors", gave readers a source of supply for magnetic materials. We have supplied samarium-cobalt magnets with all other types of permanent magnet materials since 1979. Recently we have added the new neodymium-iron-boron magnets. These offer considerable advantages over samarium cobalt: 30 per cent higher remanence, 70 per cent higher energy product, 12 lower density, 70 per cent high electrical resistivity and substantially better mechanical properties. These are available from stock and I am happy to report that some of your readers have already been supplied by us as a result of your article.

G. Watson
Magnet Developments Limited
Swindon
Wiltshire

River authority

Fred Pearce puts the case against the privatisations of the water authorities and concludes that "The water authorities are right to say their system of management, combining poacher and gamekeeper on the rivers is highly efficient" (16 July, p 32). This contradicts his comments in his book *Watershed* in which he complains of the water authorities wasting money and of bad politics and bad planning. The authorities' management must have improved considerably in the past five years.

New Scientist points out the likely need for a National Tap Water Authority (23 July, p 15), presumably to act as a competent authority to monitor the EEC's directive on drinking water. The Department of the Environment has not made clear how this is to be achieved after privatisation.

The problem of controlling discharges to sewers does not yet appear to have been tackled by the department. At the present time, the water authorities control the quality of the discharges from industrial premises by a consent procedure under the Public Health Act of 1936. This is a regulatory function and legal action is taken in criminal law against consent contravention. To be consistent this must be changed. If any other body determines and regulates discharges to sewers it would be unacceptable to the water companies which would not control inputs to sewage works.

C. Watson
Sheffield

Net cast

Your Thistle Diarist (6 August, p 65) is mistaken in thinking that the Next European Torus (NET), the successor to JET, might be sited at Culham. The EEC's Council of Ministers, meeting on 25 October 1977, to decide upon the site for JET, unanimously agreed that the member state chosen as the site for JET would not be eligible as the site for its successor.

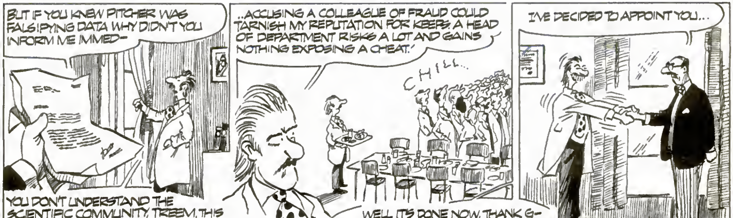
Philip Davenport
Shaftesbury
Dorset

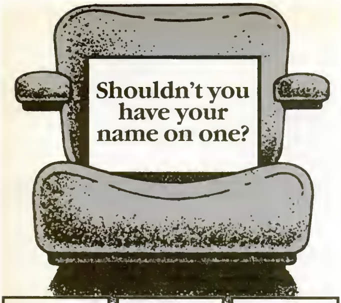
Recycled roads

Malcolm Smith correctly highlights the potential economies available from recycling and the relatively small amount of work so far conducted in Britain compared

GRIMBLEDON DOWN

Bill Tidy


BUT IF YOU KNEW PITCHER WAS FALSIFYING DATA WHY DIDN'T YOU INFORM ME IMMED—
YOU DON'T UNDERSTAND THE SCIENTIFIC COMMUNITY, TREEM, THIS IS A CLOSED TECHNICAL ENVIRONMENT AND...
..ACCUSING A COLLEAGUE OF FRAUD COULD TARNISH MY REPUTATION FOR KEEPS. A HEAD OF DEPARTMENT RISKS A LOT AND GAINS NOTHING EXPOSING A CHEAT.'
CHILL...
I'VE DECIDED TO APPOINT YOU...
WELL IT'S DONE NOW, THANK G— HEAD OF DEPARTMENT!' YOU'RE NOT—


Shouldn't you have your name on one?

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with other countries (30 July, p 34). However, Smith's remarks appear to be confined to the situation with regard to central remixing where existing road materials are taken to a plant, recycled and returned to site.

The other approach to recycling is the *in situ* concept where the road is pulverised and the aggregate remixed with either bitumen or cement as a stabilising agent. The haulage of materials on and off site is thus eliminated, making this technique financially attractive in comparison with conventional reconstruction methods.

Lincolnshire County Council carried out the first trials of *in situ* recycling back in 1985 when 1·5 kilometres of failed "drove road" were treated with bitumen emulsion to a depth of 200 millimetres. By the end of 1987, more than a dozen highway authorities in England and Scotland will have recycled highways using the *in situ* process, saving between 30 and 40 per cent on conventional construction costs.

HIGHWAY RECYCLING
ROAD UP AND DOWN AGAIN

Thus, while the Department of Transport has yet to embrace the concept of recycling for motorways and trunk roads, Britain will this year recycle more miles of county roads with the *in situ* process than any other European country.

A. J. Ferris
BOMAG
Maidstone
Kent

Ivory poachers

The article "Elephant decline blamed on ivory poachers", by Bill Forse (18 June, p 33), contains a number of misinterpretations of the proceedings of the African Elephant and Rhino Specialist Group held in Nyeri, Kenya, in May 1987. Forse attended the first part of this conference, along with a number of other participants who were not members of AERSG. During this part of the meeting, papers on various aspects of the conservation of those species were presented and discussed. The opinions voiced during this open forum were not necessarily those of the AERSG.

The second part of the conference was restricted to members of the AERSG, to enable them to tackle the business of reviewing the status of the species in detail, to pinpoint problems, and to produce action plans. The outcome of this session constitutes the official stance of the group, and Forse is ill informed on what these recommendations were. In particular, a worldwide campaign to persuade the public not to buy ivory did *not* emerge as a recommendation from the specialist group.

The group's members working in nine African countries (not three) attended the meeting, which was not a meeting of CITES and therefore did not require full representation of the African states that are a party to CITES.

WHAT WAS THAT ANIMAL THAT NEVER FORGOT?

R. F. Du Toit
African Elephant and Rhino Specialist Group
International Union for Conservation of Nature
Harare
Zimbabwe

Feed on demand

The findings reported in the article "Suckling babies thrive upon short, sharp meals" (30 July, p 23), surely support the case for feeding on demand, where a mother suckles her baby whenever it show signs of hunger, which may be very frequently indeed. It is widely accepted that such immediate response to a baby's distress offers both psychological and physical comfort, but if the results of the study in northern Thailand are taken into account, it looks as if a baby fed in this way will ingest more of the milk needed for growth and strength than a baby who is fed "by the clock".

It is quite common even now to come across the opinion that the "average" baby needs food every four hours, and that it is commendable to "train" even very young infants to comply with this regime; certainly the length of time between feeds is likely to be longer than in the case of the baby whose mother feeds on demand.

If further research confirms what the report already indicates, that is that fewer feeds mean the baby will swallow less milk, however long it may spend at the breast on each occasion, than the baby fed to a timetable is likely to be deprived of some of the milk it needs.

Alison Watson
Cadeleigh
Devon

We welcome short communications and reserve the right to edit the longer ones. Write to: Letters to the Editor, *New Scientist*, Commonwealth House, 1-19 New Oxford St, London WC1A 1NG. Or send by electronic mail to Telecom Gold Box 83: NSM005.

NORTHERN IRELAND

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There is one place in the UK which has a skills surplus and where people, once they join a company, tend to stay for years and years.

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Competitive salary + car **Colchester**

Our client, a leading force in molecular biology, has recently merged with a highly successfull Dutch company. As a result they are seeking a Sales and Marketing Manager capable of maximising the enormous potential that this new relationship offers.

Reprorting directly to the Managing Director this position offers an unrivalled opportunity for an individual seeking to gain broad management experience within a strong team committed to development of both company and individual. Your prime responsibility will be for all aspects of Sales and Marketing but you will also be expected to contribute to the overall development of the company.

You will already have a knowlege of biochemicals with particular emphasis on molecular biology combined with a broad sales and marketing background, with international experience. You will have the ability to negotiate at senior levels and have the drive and enthusiasm to succeed. Salary is negotiable and will reflect experience as well as potential, a company car will also be provided. But perhaps more importantly this is an opportunity for an individual to develop with a fast growing company yet committed to individual development.

Applicants, male or female, should apply with full career details to Lee Coole, Mercuri Urval Limited, 29 Grove Hill Road, Harrow, Middlesex, HA1 3BN

Mercuri Urval

Medicinal Chemist

Smith Kline & French Research Limited are a leading international pharmaceutical company based on an attractive site at Welwyn in Hertfordshire. Due to our current expansion we are seeking a graduate chemist to work in our Medicinal Chemistry Department, synthesising novel organic compounds of potential interest in the discovery of ethical pharmaceuticals.

The successful candidate will have; a good honours degree in Chemistry, initiative and an ability to work well with other medicinal chemists. Relevant experience within the pharmaceutical industry would be an advantage but is not essential.

We offer a competitive salary and a good range of benefits.

Please send a detailed cv quoting ref no NS/127 to Joan Cook, Personnel Department, Smith Kline & French Research Limited, The Frythe, Welwyn, Herts AL6 9AR.

SK&F

PRODUCTION MANAGEMENT

An excellent opportunity for a graduate with 2.1 degree in a biological science and an interest in brewing, to progress to a senior line management position within Guinness Brewing or one of our associated companies overseas.

Based at our Park Royal Brewery, we offer full and comprehensive training and will expose you to a wide range of experience in stout and lager brewing. Applicants must therefore be able to demonstrate the maturity and drive needed for management in a modern business.

We offer a starting salary of £9,000 plus an attractive benefits package including profit sharing, contributory pension, 5 weeks annual leave, free lunches, season ticket loan and sports and social facilities.

Please write in the first instance with s.a.f. to the Recruitment Section, Personnel Department, Guinness Brewing, Park Royal Brewery, London, NW10 7RR. Tel: 01-965 7700 ext. 3316.

GUINNESS BREWING

Quality Assurance Officer

Microbiologist for Pharmaceutical Manufacture

c£16,000 Cheshire

ICI Pharmaceuticals is a thriving research based international business. Continued success in the development of original products and the expansion of our international manufacturing base makes this an exciting time to join ICI.

As a result of internal promotion a need has now arisen for a Quality Assurance Officer to join a team concerned with the approval of processes and procedures, and the investigation of deviations. You will also ensure that Good Manufacturing Practices (GMPs) are implemented and maintained in the manufacture of bulk drugs and formulated products. Your activities will also involve the quality assurance contribution to new plants and processes, procedural changes and validations.

As a graduate specialising in microbiology, you must have experience of quality assurance or production of ethical pharmaceuticals and the application of GMP. It is also essential that you have experience in parenterals aspects of pharmaceutical production. Good communication and inter-personal skills are necessary to be effective within this position.

In return for your professionalism and expertise a salary as indicated will be offered together with excellent terms and conditions, including pension scheme and employee profit sharing. Relocation assistance will also be provided to this attractive part of the country.

Please write giving brief details of age, experience and qualifications to:

The Personnel Officer (ref JH),
Imperial Chemical Industries PLC,
Pharmaceuticals Division, Hurdsfield Industrial Estate,
Macclesfield, Cheshire SK10 2NA.

ICI is an equal opportunities employer.

ROYAL FREE HOSPITAL SCHOOL OF MEDICINE

(University of London)

Departments of Medicine and Physiology

MOLECULAR BIOLOGIST

Scientists with experience in recombinant DNA technology are invited to apply for a three year postdoctoral position funded by the Wellcome Trust.

The successful applicant will join a research group which has an interest in perinatal adaptation of the gastrointestinal tract and the relationship between defective ontogeny and inborn errors of intestinal iron binding proteins before and after birth in relation to developmental changes in iron absorption.

Experience in molecular biology is essential. Candidates of post-doctoral or equivalent status will be preferred.

Salary within Research Scales IA/IB.

Applications in the form of a full cv, including the names and addresses of two academic referees, should be sent to the School Office, RFHSM, Rowland Hill Street, London NW3 2PF (01-794 0500, Ext 4262), from which further details may be obtained. Closing date 4 September, 1987.

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF VIROLOGY OXFORD

Senior Project Leader

Applications are invited for the position of Project Leader and on the retirement of the present holder of the post, in the Summer of 1988, that of Assistant Director of the NERC Institute of Virology, Oxford.

Candidates should have a distinguished record of research in molecular virology and some laboratory management experience. Experience in biotechnology would be an advantage. The Assistant Director will be responsible for managing the Institute in the absence of the Director, Professor D. H. L. Bishop, and should therefore have an appropriate scientific reputation. However, the primary responsibility of the successful candidate will be to undertake and develop a programme of research in a field of virology that complements the areas currently under investigation in the Institute.

The post will be Grade 7 with a salary in the range £15 030-£20 292 per annum, depending on experience.

Requests for further particulars and application forms should be sent to Mrs J. Shields, NERC, Polaris House, North Star Avenue, Swindon SN2 1EU. Telephone: 0793 40101 Ext 472.

The closing date for applications is 11 September, 1987.

NERC is an Equal Opportunity Employer.

Natural
Environment
Research
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IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

Department of Computing

MICRO-COMPUTERS SUPPORT PROGRAMMER

Required for the Computing Support Group. The successful candidate will be a Computer Science Graduate, or have equivalent professional experience. He/she will have experience of a variety of micros with respect to architecture and operating systems, of graphics applications and of communications involving file transfer between micros and mainframes and terminal emulation. The micros currently in use are Z80, 8086 and 68000 based.

Five weeks annual leave. Interest free season ticket loan. Superannuation scheme. Sports centre with pool, general and music libraries, bars, restaurant and fast food facilities, all on campus.

Salary in the range £9578-£16 218 (inc).

Further details from Mr F. H. Leveque, Tel 01-589 5111, Ext 5050. Applications enclosing cv and names of two referees should be sent to Mr F. H. Leveque, Computing Support Manager, Department of Computing, Imperial College, 180 Queens Gate, London SW7 2BZ. Closing date: 11 September, 1987.

MORE VACANCIES ON PAGES 2—10

OPPORTUNITIES AT REGENT LABORATORIES IN PRODUCTION

Following the initiation of a substantial expansion programme, the following new positions have been created at Regent Laboratories in North London.

PRODUCTION MANAGER

This position would suit a pharmacist or other suitably qualified person who having a good grounding in the pharmaceutical industry, particularly in tabletting, is seeking broader responsibilities in the manufacturing area. Must be a Qualified Person under the Medicines Act. Age is unlikely to be a problem.

PRODUCTION PHARMACISTS

There are two vacancies for pharmacists male or female who are already in production, who would like increased responsibilities and the opportunity of working with a wide range of products.

These are important and interesting positions not only because of the wide range of products produced by Regent but also because of the chance to become familiar with traditional and modern pharmaceutical equipment. The posts provide the opportunity of gaining valuable production management experience.

PRODUCT REGISTRATION OFFICER

In order to deal with an increasing amount of registration work Regent is seeking the services of a suitably experienced person who can join the present team and make a real contribution to the work of the Registration Department. Because of the nature of registration work hours can be entirely flexible and arranged to suit the person concerned.

Regent is an associate company of the Letap Group and the combined interests of the whole organisation now encompass three manufacturing sites in the UK alone. These positions represent an ideal opportunity for joining an expanding organisation at a significant time in its growth.

There are the usual company benefits.

Apply in the first instance to Mr D. Holman, Regent Laboratories Ltd., Cunard Road, North Acton, London NW10 6PN. Tel 01-965-3637.

UNIVERSITY COLLEGE LONDON

Department of Chemistry

POSTDOCTORAL RESEARCH ASSISTANT

Synthesis and Evaluation of Novel Anti-Aids Drugs

Applications are invited for a post, funded under the recent MRC initiative directed towards novel anti-AIDS drugs.

In particular, the work will involve the synthesis and biological evaluation of novel nucleoside derivatives.

Prior research experience in synthetic organic chemistry is essential. Experience in nucleoside chemistry and/or biochemical techniques would be an advantage.

The appointment will be for one year from October 1987 in the first instance, renewable for a second year by mutual consent. Initial salary will be up to £9865 plus £1393 LA (on the RA1A scale).

Applications with full cv and the names and addresses of two referees should be sent to Dr C. McGuigan, Department of Chemistry, University College London, 20 Gordon Street, London WC1H 0AJ.

GRADUATES

The Sigma-Aldrich group is a market leader in the manufacture and supply of fine chemicals and biochemicals for research use. Continued expansion of current business and, the movement into new product areas has led to a vacancy in our distribution unit in Gillingham, Dorset. We are therefore looking for applications from young chemistry graduates in order to strengthen our purchasing/sales team.

Please send cv or telephone for an application form: Miss S. E. Streeter, Aldrich Chemical Co Ltd, Gillingham, Dorset SP8 4JL. Tel (07476) 2211.

WEST YORKSHIRE HIGHWAYS, ENGINEERING AND TECHNICAL SERVICES JOINT COMMITTEE

West Yorkshire Highways, Engineering & Technical Services Joint Committee (HETS) has been established to provide specialist professional services to the five district councils in West Yorkshire. In addition we offer similar specialist cost-effective services to other organisations. HETS is an approved ICE Training Organisation.

TRANSPORTATION NOISE STUDIES

ASSISTANT ENGINEER UB2413(1)

Grade SO2 £12 156-£12 882

Applicants are invited to join a team within the noise studies group based at Dudley House in Leeds. The group forms part of the overall Traffic and Transportation Unit of HETS and deals with the environmental problems arising from road, rail and air transport in West Yorkshire.

The person appointed will be primarily responsible for developing existing schemes to monitor and control aircraft noise at Leeds Bradford airport, in addition to the evaluation and solution of road traffic noise problems, with particular reference to heavy lorries.

Candidates should preferably have experience appropriate to the responsibilities of the past and be educated to degree standard in a relevant subject, although applications from HND/HHC holders will be considered.

Application forms can be obtained by writing, enclosing a large SAE, to the Personnel Officer, Highway Engineering and Technical Services, Selectapost 6, Dudley House, 133 Albion Street, Leeds or by telephone on Leeds 462608.

Closing date: 7 September, 1987.

"HETS IS AN EQUAL OPPORTUNITIES EMPLOYER"

Post suitable for Job sharing.

Anglian Water

Water Quality Officer

£8556–£9570 (pay award pending)

LOCATION: Cottonvalley, Milton Keynes

Due to an internal promotion, we have a vacancy for a Water Quality Officer to join our multi-functional team engaged in providing an effective pollution prevention service in the Milton Keynes area of Cambridge Division.

Duties will involve routing sampling and inspection of trade effluents, dealing with complaints and pollution incidents, advising on pollution prevention, and collation interpretation and use of technical data for trade effluent charging.

Applicants should have at least an HNC or equivalent qualification in an appropriate Science or Technology subject. Previous experience in pollution control work would be advantageous, but is not essential.

Good conditions of employment include a 37 hour week, a minimum of 22 days holiday plus bank holidays and a contributory pension scheme.

An application form and job description may be obtained by telephoning our Personnel Section on Cambridge (0223) 61561, Ext. 240 (ansaphone) between 8.30 am and 5.00 pm Monday to Friday, quoting the post title.

Completed application forms must be returned by 7 September, 1987.

CAMBRIDGE DIVISION
Great Ouse House, Clarendon Road, Cambridge CB2 2BL

AN EQUAL OPPORTUNITY EMPLOYER

Opportunities in Pharmacology

Salary range £8,000-£13,000 Beckenham, Kent

The Department of Systems Pharmacology at Wellcome undertakes programmes of research aimed at the development of novel therapies for cardiovascular and neurological disease.

We currently have three vacancies for technical research staff to join us in the following areas:-

Psychopharmacology/Behavioural Pharmacology

Working with our research team you will be involved with the investigation of potential psychotherapeutic agents and the behavioural assessment of novel drugs from other therapeutic areas.

Candidates should possess a degree/HTEC qualification in pharmacology, preferably with research experience in the field of animal behaviour and practical experience in the laboratory use of microcomputers. (Ref. 079a).

Vascular Pathophysiology

We have two positions within this section involved in the investigation of new therapeutic approaches in the field of atherosclerosis.

The more senior position will be involved in experiments to assess *in vivo* drug efficacy in support of Programme and Exploratory research activities. You will ideally possess two years' post-graduate laboratory experience using *in vivo* techniques. (Ref. 079b).

In the more junior post, responsibilities will include the undertaking of routine pharmacological and biochemical assays and the development of new techniques. No post-graduate experience is necessary. (Ref. 079c).

Both positions require a degree or equivalent in pharmacology, physiology or applied biology.

In addition to an attractive salary, we offer excellent benefits which include, 5 weeks' holiday, pension scheme, first class sports and social club facilities, subsidised restaurant and assistance with relocation expenses where appropriate.

Interested candidates should write for an application form to Dr Hilary Avahu, Senior Personnel Officer, The Wellcome Research Laboratories, Langley Court, Beckenham, Kent BR3 3BS, quoting the appropriate reference number.

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Wellcome

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FORMULATION SCIENTIST

Arthur H. Cox and Company Limited is part of a major international pharmaceutical company and manufactures and markets a wide range of generic, OTC and ethical products.

As a result of expansion within our Product Development Department, a vacancy has arisen for a Formulation Scientist.

We are inviting applications from candidates with experience in the formulation of solid dosage forms, or new graduates seeking a career in this field. The successful applicant will join a team responsible for the formulation and process development of a wide range of generic, OTC and ethical products.

Please apply with full cv to Mr R. Forsythe, Personnel Manager, Arthur H. Cox & Co Limited, Whiddon Valley, Barnstaple, North Devon EX32 8NS. Tel (0271) 75001.

MEDICAL INFORMATION OFFICER

An opportunity has arisen for a Medical Information Officer to work in the Medical Department of Smith & Nephew Pharmaceuticals Ltd.

The successful applicant will report directly to the medical adviser and would be responsible for the library and information service and in assisting in responding to a wide range of technical and medical enquiries. Attention to detail, good skills in written and verbal communication and a highly professional attitude is a necessary prerequisite for this important role.

Suitable candidates should have a good degree in a biological science; preferably in pharmacology. An MSc in information science or experience in medical information is desirable.

Application forms may be obtained from Mr L. Dorrell, Divisional Personnel Manager, at the following address:

SMITH & NEPHEW
PHARMACEUTICALS LTD
BAMPTON ROAD
HAROLD HILL
ROMFORD
ESSEX RM3 8SL

Smith+Nephew

UNIVERSITY OF NEWCASTLE UPON TYNE

Department of Electrical & Electronic Engineering

A temporary post in this Department, supported by funds from British Telecom, for a period of 17 months. You will be expected to be suitably qualified and to have had postgraduate experience either in industry or a University in one or more of the following fields:—

Communications Systems
Signal Processing
The application of IKBS techniques.

Preference will be given to candidates with experience in these areas although consideration will be given to well qualified candidates with research interest in any area of electronics.

Further details of the post from and applications (three copies) to the Senior Assistant Registrar (Establishments) The University, 6 Kensington Terrace, Newcastle upon Tyne NE1 7RU together with the names and addresses of three referees by 7 September, 1987.

INSTITUTE OF PSYCHIATRY

Department of Neurology

RESEARCH ASSISTANT

Applications are invited from recently qualified graduates in biochemistry or pharmacology to undertake a three year project on the involvement of toxic mechanisms as a cause of Parkinson's disease. The study involves the measurement of indices of lipid peroxidation, metal ions and the levels of protective enzyme systems in post mortem human brain. Experience of enzyme assays would be an advantage.

Initial salary: £8185 pa, plus £1393 London Allowance on the 1B Research Scale.

Further information can be obtained from Dr P. Jenner, Department of Neurology; 01-703 5411, Ext 245.

Application forms can be obtained from the Assistant Secretary's Office, Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AF quoting Ref PJ/.

Closing date is 11 September, 1987.

MORE VACANCIES ON PAGES 2—10

BSI is the focus for UK activity in standards and quality.

Information Scientist c. £10,575

The postholder will be required to design, test and demonstrate systems, to retrieve information, provide support and assistance and manage the day to day maintenance of the STANDARDLINE database.

Although reporting to the Head of Database section, the jobholder is expected to work without detailed supervision, and applicants should therefore have previous experience of information work preferably of a technical nature. Candidates should also possess a Degree or equivalent in Information Science or a technical subject.

Information Officer c. £7,797

The job involves indexing documents for input, setting up search profiles and contributing to work on new information, products and services. The successful applicant will become part of the Database team which designed, prepared and now maintains BSI STANDARDLINE.

Applicants should be qualified to Degree Level in a science or related subject, and have the ability to work to a high level of accuracy, showing imagination in adapting services to meet the changing needs of today's client and technology.

Based at our Milton Keynes office, benefits include 5 weeks' annual leave, contributory pension scheme and sports and social club.

For an application form please telephone:
Mr. M. Fleming, Personnel Officer,
BSI, Linford Wood, Milton Keynes MK14 6LE
Tel: (0908) 220022 Extension 2269

BSI

Working for Quality

PUBLIC HEALTH LABORATORY SERVICE BOARD

Area Public Health Laboratory—Ashford

SENIOR MEDICAL LABORATORY SCIENTIFIC OFFICER (VIROLOGY)

For the joint PHLS/Health Authority Microbiology Department, providing a clinical laboratory service for the South East Kent Health Authority and Public Health Laboratory Service for Kent. In addition, the virology service covers four further Health Authorities in Kent.

A wide range of serological investigations is undertaken, along with extensive tissue culture, immunofluorescence and electron microscopy; (Zeiss EM 109).

You should have broad experience in tissue culture, serology, immunofluorescence and electron microscopy; a working knowledge of microcomputers would be an advantage. State registered MLSOs holding FIMLS in virology are invited to apply.

For informal visits to the laboratory, contact the Chief MLSO (Virology), Mr J. Jones, Tel (0233) 35731.

Job description and application form from the Director, Public Health Laboratory, The William Harvey Hospital, Kennington Road, Willesborough, Ashford, Kent TN24 0LZ.

Closing date: 21 September, 1987.

RIVERSIDE HEALTH AUTHORITY

Division of Pathology

St Stephen's Hospital

MEDICAL LABORATORY SCIENTIFIC OFFICER

For the Department of Chemical Pathology in this busy District General Hospital. The Department is well equipped and includes radioimmunoassay and toxicology sections.

For further details please contact Mr R. Plant, Senior Chief MLSO. Tel 352-8161, Ext 306.

Application form and job description available from Personnel Department. Tel 725-7027 (24 hours).

Closing date: 4 September, 1987.

UNIVERSITY OF SOUTHAMPTON

DEPARTMENT OF CHEMISTRY

Design of Novel Spectroscopic Equipment

An exciting and unusual opportunity exists to join a team engaged in the development of new reflectance spectroscopy instrumentation. This equipment is likely to find wide application in surface science, including semi-conductor characterisation and corrosion studies, and in areas of medical research. The implications are such that considerable commercial financial backing is available for the project.

The successful applicant will be involved in all phases of design and testing from the laboratory through to a prototype for manufacture. Applications will be particularly welcome from persons with research experience up to PhD or equivalent level, especially in relevant areas such as laser optics, computer programming for data processing and real-time control of instruments. Salary will be in PDRA/A scale range £9305-£14 825 pa commensurate with age and experience as well as USS benefits if appropriate.

Applications with the names of two referees should be sent to: Dr R. Greef, Chemistry Department, The University, Southampton SO9 5NH, UK.

UNIVERSITY OF LEEDS
DEPARTMENT OF ORAL BIOLOGY

TECHNICIANS

Applicants are invited for the following technical posts:-

POST 1
Required for two years to work on a research project into the behaviour to tooth enamel under oscillating conditions on pH. The project will involve enamel surfaces being subjected to pH changes similiar to those experienced in the mouth and assessing changes in the tooth surface after treatment by chemical and histological examination.

POST 2
Required for three years to work on a research project involving biochemical analysis of crevicular fluid (ie fluid which exudes from the tooth gingiva function). Techniques will include glycosylaminoglycons, electrophoresis and antibody assay using ELISA techniques. The results will assist in diagnosis, prediction and monitoring treatment of periodontal disease.

Applicants for both posts should be qualified to ONC or equivalent level and have had some laboratory experience. Graduates in Biochemistry/Chemistry are also invited to apply. Salary on the grade 3 scale £6314 to £7488 pa. Applications in writing giving details of age, qualifications and experience and the names and addresses of two referees should be sent to Dr C. Robinson, Department of Oral Biology, School of Dentistry, Clarendon Way, Leeds LS2 9LU by 28 August, 1987.

MEDICAL PHYSICS TECHNICIAN

Grade IV, Department of Clinical Physics and Bio-engineering

Duties at Southend Hospital will be mainly in the Clinical Physics Section and include investigations in Nuclear Medicine as well as lung physiology. Some occasional duties in the Radiation Physics Section will also be required.

Qualifications: ONC–OTEC or higher qualification in appropriate subject. Hours; 37 per week

Salary: Medical Physics Technician IV (with ONC) £5992–£7877 pa.
Medical Physics Technician IV (higher Qualification) £6282–7877 pa.

MEDICAL LABORATORY SCIENTIFIC OFFICER

(MLSO) Microbiology

Our preference is for an experienced, state-registered MLSO, but we will welcome applications from holders of relevant science degrees, who wish to work and train in a progressive, well equipped laboratory. Further study, leading to Fellowship of Institute of Medical Laboratory Sciences will be actively supported. Applications from those with two approved Science 'A' levels may be considered for the post.
Salary depends on age and qualifications.

Interested? For further details about a career in medical microbiology please contact Mrs C. Davies or Miss R. Jarvis (Chief MLSO's) on (0702) 348911, Ext 2340.

Application Form and Job Description for the above two posts are available from Unit Personnel Department, Southend Hospital, Prittlewell Chase, Westcliffe-on-sea, Essex SS0 0RY. Tel (0702) 348911, Ext 2423

An Equal Opportunities Employer

SOUTHEND
HEALTH AUTHORITY

TRIBOLOGIST

Engineering Research in Mining

"Water as an Hydraulic Fluid"

South Africa

★ Our Client a world leader in the field of specialized hydraulic systems for use in the mining industry, requires a self motivated, innovative team leader to head up the research programme into this critical and fast developing area of high technology.

★ This position involves the detailed study and evaluation of the diverse effects of utilising water as an hydraulic fluid to power rock breakers and drills, and to evolve new materials, systems and equipment to overcome the technical difficulties involved.

★ The ideal candidate must be qualified to at least Degree level, in either Metallurgy, Materials, Mechanical Engineering or Hydraulic Engineering, with at least five years' relevant research experience.

★ Based in the Johannesburg area this appointment is offered on a permanent basis. In addition to an attractive salary, our Client offers free family passages, a generous relocation allowance, assistance with initial accommodation, pension and medical aid scheme membership, a subsidised canteen and group life assurance.

★ South Africa offers a high standard of living in a beautiful country with an ideal climate and excellent social, educational and recreational facilities. Detailed information regarding our Client and life in South Africa will be provided at the interview stage.

★ Please telephone Ralph Steward for a preliminary discussion or write in strict confidence enclosing a detailed CV to the address below quoting reference PA 80/NS.

Ashbrittle Limited
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WEST BERKSHIRE HEALTH AUTHORITY

Royal Berkshire Hospital, London Road, Reading RG1 5AN

Public Health Laboratory and Department of Microbiology

MEDICAL LABORATORY SCIENTIFIC OFFICER OR JUNIOR 'B' MLSO

Two full time vacancies have arisen in this busy department, which handles about 160 000 specimens per year. The posts are ideally suited to state registered MLSO's but consideration will be given to degree and 'A' level candidates.

Successful applicants will have the opportunity to work in all sections of the laboratory, including Virology. Facilities for training and further study are available. A busy on-call service operates (for suitably qualified staff).

Further information may be obtained from Mr J. McKenzie, Senior Chief MLSO, Tel Reading (0734) 863115.

Application forms and job descriptions from Mr B. Walsh, Principal MLSO, Pathology Laboratory, South Wing, Royal Berkshire Hospital, London Road, Reading RG1 5AN.

Closing date: 25 September, 1987.

UNIVERSITY OF MANCHESTER

Department of Pharmacy

RESEARCH TECHNICIAN

required to join a new multi-disciplinary research group, headed by Professor Kenneth T. Douglas, working on the design of new anti-cancer drugs. The work will involve the care and operation of a wide range of equipment as found in biochemical and organic laboratories active in protein and nucleic acid chemistry and the post offers good career prospects for the right person. Experience with, or interest in, HPLC and microprocessors would be advantageous.

Initial salary £6314-£7448 pa. Applications to: **Professor K. T. Douglas, Department of Pharmacy, University of Manchester, Oxford Road, Manchester M13 9PL by 7 September.**

INSTITUTE OF MOLECULAR MEDICINE

Medical Laboratory Scientific Officer

Salary: £7125-£8986

An MLSO is required immediately to work in the Developmental Physiology Laboratory on the expression of selected oncogenes in developing tissues. Applications are invited from those who preferably have experience of a wide range of biochemical techniques. The Laboratory is at present located in the Radcliffe Infirmary, Woodstock Road, Oxford, but will move into the Molecular Medicine Institute, John Radcliffe Hospital, when opened next year. Posts are currently for five years in the first instance.

Applicants should apply immediately in writing to: Dr C. T. Jones, St Catherine's College, Manor Road, Oxford, enclosing a curriculum vitae together with the names and addresses of two referees.

INSTITUTE OF CANCER RESEARCH AND ROYAL MARSDEN HOSPITAL

Fulham Road, London SW3 6JJ

Joint Department of Physics

POSTDOCTORAL RESEARCH PHYSICIST

The appointee will be joining a small group of scientists investigating the X-ray properties of soft tissue tumours and developing methods of enhancing X-ray images. Experience in computer image processing techniques desirable. Appointment for three years. Starting salary will reflect qualifications and experience and will be on MRC Non-Clinical Scientific Scale within the range of £9305-£13 675 pa plus London Allowance of £1393.

Applicants are advised that in the majority of the Institute's premises smoking is prohibited.

Applications in duplicate with the names and addresses of two referees should be sent to: The Personnel Officer, The Institute of Cancer Research, 17A Onslow Gardens, London SW7 3AL, quoting Ref No 8/87/S/N/98.

MORE VACANCIES ON PAGES 2–10

Agronomist - Yemen

The Central Highlands Rural Development Project in the Yemen is a joint funded development in which the Overseas Development Administration has a particular interest. At Dhamar the project team's key objectives is to increase farm incomes through production increases. The semi-arid project area is 4,500 to 8,000 feet above sea level which permits a great variety of crops to be grown.

An Agronomist is now required to review agronomic research to date, implement a trials programme, help with crop production costs and assist with tillage trials. You will also take overall charge of day to day running of the project farm in consultation with the project leader and co-manager.

Applicants should be British citizens with a degree in Agriculture, a post-graduate qualification and at least five years overseas experience which should have covered rainfed and irrigated agronomy. Any involvement in adaptive research and/or extension work with small farmers would be useful, as would any knowledge of Arabic.

The appointment is on contract to ODA, on loan to the Government of Yemen, for a period of 2 years. Salary (UK taxable) is in the range £16,525 to £20,400 pa depending on qualifications and experience and will include an element in lieu of superannuation which will be abated if ODA can continue payment into candidate's existing fund. A tax free cost of living allowance, currently in the range £3,986 to £6,547 pa is also payable.

The post is wholly financed by the British Government under Britain's programme of Aid to the developing countries. Other benefits normally include paid leave, free family passages, children's education allowances, free accommodation and medical attention.

For an application form, please write, quoting ref. AH367/IMcK/NS, **stating post concerned,** to: Appointments Officer, Overseas Development Administration, Room 351, Abercrombie House, Eaglesham Road, EAST KILBRIDE, Glasgow G75 8EA. Or telephone 03552 41199, extension 3526 and 3435.

ODA OVERSEAS DEVELOPMENT

Britain helping nations to help themselves

Section Head Quality Assurance

At our modern production complex in Irvine, Ayrshire we employ approximately 800 staff in the bulk manufacture of a wide range of pharmaceutical intermediates and finished products. Quality Assurance plays a key role in ensuring the integrity of these, and we are currently seeking to recruit a Section Head for our bulk production laboratory.

The job holder will report to the Unit Manager and will be responsible for directing and co-ordinating the work of a small technician staff in assessing the quality of Site production. This will involve close liaison with production colleagues and candidates should be familiar with GMP and a wide range of modern analytical techniques including HPLC and GLC.

Applicants, male or female, will be upwards of 25 years of age and will be honours graduates in Chemistry preferably with some relevant experience of a bulk pharmaceutical or fine chemical environment.

In return we offer a competitive salary and generous fringe benefits package including relocation assistance where appropriate.

Written applications enclosing brief career details should be made in the first instance to: The Personnel Officer, Beecham Pharmaceuticals, U.K. Division, Shewalton Road, Irvine, Ayrshire KA11 5AP.

Beecham
Pharmaceuticals

UNIVERSITY OF SURREY
Department of Mathematics
RESEARCH OFFICER

A Research Officer is required to work on a project entitled "Robust Inference for Stochastic Processes". This project has been funded by the SERC under the complex Stochastic Systems initiative.

The Research Officer will work with the four staff in the field of Statistics, Dr M. J. Crowder, Dr A. C. Kimber, Prof R. L. Smith, and Dr T. J. Sweeting, on the development of new analyses and algorithms for inference from stochastic processes. Particular themes expected to be stressed are graphical methods for outlier detection and model selection and the new methods of fitting models, including quasi-likelihood. The bulk of the work will involve use of a SUN system for the development of both graphical and powerful numerical procedures.

The appointment is for three years. The initial salary will be up to £8735 pa on the Research and Analogous 1B scale. Superannuation under USS conditions. Qualifications required are a first- or upper second-class degree in Mathematics or Statistics, and substantial programming experience. The Research Officer may choose to register part-time for a PhD.

Enquiries may be made to Dr M. J. Crowder, Department of Mathematics, (0483) 571281 Ext 2621 or 2644. Applications in the form of a cv (three copies) and including the names and addresses of two referees should be sent to (JLG) Personnel Office, University of Surrey, Guildford, Surrey GU2 5XH, by 8 September, 1987, quoting Ref 649.

UNIVERSITY OF ABERDEEN
Department of Zoology
RESEARCH ASSISTANTS

Applications are invited from suitably qualified graduates for two posts:

1. Energetics of Hibernating Bats. To work with Prof P. A. Racey and Dr J. R. Speakman on the effects of disturbance on the energy expenditure of bats hibernating in caves, using the doubly-labelled water technique. The appointment, which is for one year, is funded by the Nature Conservancy Council. (Ref WS/038).

2. In vitro Fertilisation in Cephalopods. The work will involve the development and preparation of culture media for eggs and sperm of the octopus Eledone cirrhosa. Experiments on the conditions required for fertilisation will be coupled with light and electron microscopy of the gametes. The work is funded by a grant from the University Research Committee for one year to Prof P. R. Boyle and will be closely integrated with existing research on cephalopod biology. (Ref WS/039).

Salary for both posts, starting 1 October 1987, will be £8185 pa on IB Scale. Further particulars and application forms available from The Personnel Office, The University, Regent Walk, Aberdeen AB9 1FX (Tel 0224 480241, Ext 5351/4) to whom applications (two copies) and a full cv should be returned by 11 September, 1987.

SCOTTISH CROP RESEARCH INSTITUTE
Invergowrie, Dundee DD2 5DA

HIGHER SCIENTIFIC OFFICER (BAND I)

(3-Year Appointment)

Mycology and Bacteriology Department

Applications are invited for the IFS post to work on oxygen and temperature regulation of pectic enzymes produced by the soft rot coliform *Erwinia carotovora* using a molecular genetics approach based on transposon mutagenesis and gene fusion technology. The project is part of an on-going study of the molecular biology of pathogenicity determinants in *E. carotovora*. This is a three year appointment available from 1 October, 1987.

Qualifications: First or upper second class honours degree with at least two years post-qualifying relevant research experience which may be a course of research and study leading to a PhD degree.

HIGHER SCIENTIFIC OFFICER (BAND 1)

(3-Year Appointment)

Applications are invited for this PMB funded post to work on the survival and multiplication of *Erwinia carotovora* in potato tuber wounds as affected by tissue preformed resistance in relation to pO_2. This is a three year appointment available from 1 October, 1987.

Salary scale: £9219-£12 505.

Qualifications: First or upper second class honours degree with at least two years post-qualifying relevant research experience preferably in plant biochemistry which may be a course and study leading to a PhD degree. A microbiological background would be useful but is not essential.

Non-contributory superannuation.

The Institute is an equal opportunities employer.

CV complete with the names and addresses of two referees should be sent to Miss J. A. Murray, Personnel Officer, by Friday 11 September, 1987.

UNIVERSITY OF EDINBURGH
Department of Psychology

POSTDOCTORAL RESEARCH FELLOWS— TWO POSTS

Applications are invited for the above posts in a research group working on the perceptual (particularly visual) control of posture and movement. The posts will involve the analysis of perceptuo-motor performance in normal adults and brain damaged adults suffering perceptuo-motor dysfunction—in particular, cerebellar ataxia and unilateral spatial neglect. The work will complement current work of the group on the development of perceptuo-motor control in normal and brain damaged infants. Applicants should hold a PhD. One post, funded for three years, requires prior training in psychology or a related discipline and research experience in analysis of perceptuo-motor performance. The other post, funded for one year with expectation of a further two years, requires prior training in mathematics, physics, computer science or engineering, with skills in computer programming and electronics.

The posts are available immediately. Initial salary will be in the range £9305-£11 015.

Applications including a cv and names of two referees should be sent to Dr D. N. Lee, Psychology Department, University of Edinburgh, Edinburgh EH8 9JZ, by 9 September, 1987. For further information, telephone 031-667 1011, Ext 4468.

Please quote reference number 5485.

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UNIVERSITY OF LEICESTER

SENIOR ANIMAL TECHNICIAN—GRADE 6

Salary £8827-£10 642.

A vacancy exists for an animal technician with at least eight years experience to deputise for the Departmental Superintendant of a busy multi-disciplined animal unit. Experience of breeding inbred rodents would be an advantage. Applicants should hold at least the IAT Associateship or B/TEC Animal Technology equivalent, and be familiar with the Animals (Scientific Procedures) Act 1986, and its administration. An aptitude for staff management and good record keeping is essential. The post holder would also be expected to take his or her turn in the carrying out of weekend and holiday duties.

Applications, together with cv, giving the names of two referees, should be sent to: The Senior Assistant Registrar, The University of Leicester, University Road, Leicester LE1 7RH.

WEST LAMBETH HEALTH AUTHORITY

St. Thomas' Hospital, London SE1

Senior Technician

Phipps Unit

£9758–£11 875 inc.

To join a small team responsible for the maintenance of ventilators and respiratory equipment used in Phipps Unit and by physically disabled patients living in the community. Duties of the post include organising and supervising the work of three other technicians, servicing and installing respiratory equipment in the patients homes, providing technical support and advice to the unit, assisting with the transportation of respirator dependent patients and providing an emergency out of hours on-call service.

A ONC, HNC or HND or O Tec in electrical or mechanical engineering, medical physics or related fields is desirable. A clean driving licence and an ability to manoeuvre heavy equipment are essential. Informal visits to Phipps Ward are welcomed.

For further details please contact Anne Royle, Acute Unit Administration, St. Thomas' Hospital—01-928 9292 Ext 2102.

Ref No. P/100.

Research Assistant (MLSO Scale)

The Gastrointestinal Laboratory, The Rayne Institute

£7569–£10 187 inc.

For a study into the role of dietary constituents in the aetiology of Crohn's disease (Inflammatory Bowel Disease). The work will principally involve X-ray microanalysis, a modification of electron microscopy, and training for this will be provided. Candidates with any scientific background are invited to apply, but a knowledge of analytical techniques and computer handling of data would be an advantage. Minimum educational requirement HND or equivalent, but an honours degree would be preferable. The appointment which will be for 12 months in the first instance.

Ref No. P/99.

For application form and job description, please write to the Personnel Department, or telephone our 24 hour Monday to Friday answering service on 01-261 1185 quoting the appropriate job title and job reference. Closing date for completed application forms is 3 September, 1987.

AN EQUAL OPPORTUNITY EMPLOYER

SOUTHMEAD HEALTH AUTHORITY

South West Regional Cytogenetics Centre

CLINICAL CYTOGENETICIST (BASIC GRADE)

Salary £7716-£9946 pa.

Required to work in the Regional Cytogenetics Centre, which provides a fully comprehensive diagnostic cytogenetics service. This Centre's interests include an active in-vitro fertilisation programme and the development of recombinant DNA techniques.

Applicants should have a first- or second-class Honours degree in Genetics or an appropriate Biological Science. Experience in Cytogenetics would be an advantage but training will be given and recent graduates will be considered.

Application forms from Unit Personnel Department, The Bungalow, Southmead Hospital, Bristol BS10 5NB. Tel 0272-505050, Ext 2766. Closing date: 11 September 1987.

HAEMATOLOGY DEPARTMENT

JUNIOR 'B' MEDICAL LABORATORY SCIENTIFIC OFFICER

Salary: £6139-£6306 pa inc.

The department provides a diagnostic service for routine haematology coagulation and haemoglobinopathy, as well as blood banking facilities for this busy district general hospital.

Applications are welcome from science graduates or holders of two science 'A' Levels.

Excellent training opportunities for IMLS Fellowship with good postgraduate library facilities available from this department, linked with the University of London.

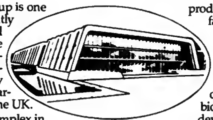
Please apply by cv to Unit Personnel, Central Middlesex Hospital, Acton Lane, London NW10 7NS, or Tel 01-965 5733, Ext 2484 for application form.

Central Middlesex Hospital working for Equal Opportunities.

MORE VACANCIES ON PAGES 2–10

Where Talent and Technology Focus on Health

New Graduate Opportunity



Napp Pharmaceutical Group is one of Europe's most consistently successful pharmaceutical companies and our unique combination of technical innovation and sales and marketing expertise has firmly placed us in the top 25 pharmaceutical operations in the UK.

Our superb all purpose complex in the Cambridge Science Park contains production and pharmaceutical facilities widely regarded as being among the ultimate currently available in Europe, and their capabilities have been strengthened by the recent formation of our own in-house Microbiology Department. Further development of this function means that we now require a

Microbiologist

Circa £8,000

Reporting to the Head of Microbiology, the successful candidate will assist in providing a broadly based service to the Production, Quality and R&D Departments by carrying out a range of activities including media preparation, sample testing and project work.

This is an ideal opportunity for a new graduate as we offer training and experience which will enable a strongly motivated self-starter, who possesses a degree (or equivalent) to build a firm foundation for a career in the health care industry.

We also offer an excellent salary, annual bonus scheme, pension scheme, free life assurance, 35-hour week, 23 days' holiday, subsidised company restaurant and sports and social club.

Interested? Please call our Personnel Applications Section on Cambridge 358888 extension 2000 for an application form.

NAPP LABORATORIES
The Science Park, Cambridge CB4 4GW

NAPP *Member of Napp Pharmaceutical Group*

UNIVERSITY OF OXFORD
Metabolic Research Laboratory
Nuffield Department of Clinical Medicine

Applications are invited for the post of

POSTDOCTORAL RESEARCH FELLOW

in a small but lively group funded by the Medical Research Council. The programme of research is concerned with the hormonal and nutritional regulation of mammalian metabolism in physiological and pathological states. The present post would be in the area of the short-term regulation of lipid metabolism in liver, mammary gland and other tissues during nutritional or hormonal transition states. Applicants should have a PhD or equivalent qualifications and have genuine interest in metabolic regulation at the physiological level. Necessary training in in vivo techniques, preparation of isolated cells (hepatocytes, mammary gland secretory cells, adipocytes) and cell culture would be available.

The post is for three years and will be on the Universities Research Grade 1A scale, in the range of £9305-£11 015, depending on age, qualifications and experience.

Applications in the form of a cv including names and addresses of two referees should be sent to Dr D. H. Williamson, Metabolic Research Laboratory, Nuffield Department of Clinical Medicine, Radcliffe Infirmary, Woodstock Road, Oxford OX2 6HE.

CAMBRIDGE UNIVERSITY
Department of Materials Science and Metallurgy
Pembroke Street

POST-DOCTORAL RESEARCH ASSISTANT IN POLYMER SCIENCE

Applications are invited for the post of Research Assistant to study molecular conformations and packing in cross-linked polymer systems. The research will centre on the techniques of wide angle X-ray diffraction coupled with on-screen molecular modelling.

The appointment will be for two years in the first instant, and applications giving the names of two referees should be addressed to the supervisor, Dr A. H. Windle, at the above address. Salary will be age related on the national scales.

SENIOR ANALYST (Radiochemistry)

Redcross Street, Bristol

Salary: Scale SO1/PO (1-4) £11 070-£13 506

You must have previous practical experience in radiochemical techniques and preferably be a graduate chemist with a knowledge of analytical chemistry.

The postholder will be required to establish and maintain a programme of work to measure and interpret low level radioactivity in support of the County contribution to Environmental Radiation Monitoring in the Severnside area (RADMOSS). Other duties will include general analytical chemistry in the County Laboratory.

Application by form only available with further details from Director of Personnel Services, Avon House, The Haymarket, Bristol BS99 7HE, or telephone Bristol 298565 (Ansafone on this number after office hours).

Please quote reference number ANA/220/3P when asking for forms, which must be returned by 3 September, 1987.

Scientific Services Department

Avon as an Equal Opportunities employer considers applicants on their suitability for the post, regardless of sex, race, disability or sexual orientation.

Avon
COUNTY COUNCIL

ELECTRO-OPTICS

Engineers and Scientists educated to BSc/MSc/PhD levels are required to work as Development and Design Engineers in visible and infra-red systems, within various high technology companies.

Opportunities exist in:
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Please phone for an Application Form or write with details listing your phone number for contact.

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AMES PERSONNEL

Clinical Research Associate

Our research programme is developing rapidly and there is now a need to expand our capacity by appointing a Clinical Research Associate. This position will involve assisting in the planning, design, initiation, monitoring and reporting of clinical trials with Lorex marketed compounds. These studies will be predominantly phase 4, but may include work with as yet, unmarketed products. Projects currently underway cover all aspects of clinical research from volunteer studies to post-marketing surveillance.

The person appointed will be of proven scientific and/or medical ability with appropriate qualifications. He or she will have an open and enquiring mind and will be able to communicate effectively and tactfully, both verbally and in writing with investigators and colleagues. Previous experience in cardiovascular and/or CNS clinical research would be a distinct advantage, although not an absolute requirement for the right candidate.

Lorex Pharmaceuticals is a rapidly developing pharmaceutical company with French and US connections and a distinctly unique style. We offer a competitive salary, company car, pension and life assurance schemes, private health insurance and never a dull moment.

If you are interested in this vacancy, please write or telephone for an application form to: Mrs J Penwill, Personnel Administrator, Lorex Pharmaceuticals, Old Bank House, 39 High Street, High Wycombe, Bucks, HP11 2AG. Tel: 0494 26188.

LOREX
PHARMACEUTICALS

GENETICS INTERNATIONAL
(UK) INC

GRADUATE SCIENTIST

We are an American biotechnology company involved in the production of health care and diagnostic products. We are seeking a highly motivated scientist to join a small team within the research group working on novel immunoassay formats. The successful applicant will have a good honours degree in a life science together with at least one year's experience in immuno diagnostics.

In addition to a competitive salary (£10 000–£13 500 depending on experience) the Company offers a generous relocation allowance, staff pension and stock option scheme.

Applications with full cv and the names and addresses of three referees should be sent to:

Dr N. C. Foulds,
Genetics International, (UK) Inc,
38 Nuffield Way,
Abingdon,
Oxon OX14 1RL

Bioanalyst

Cheshire

An opportunity exists within the Pharmacokinetics Section of Safety of Medicines Department for a graduate to join a team generating pharmacokinetic data to support the selection, safety evaluation and clinical assessment of new drugs.

The successful candidate will have at least three years' post graduate experience of the determination of drugs in biological fluids and the protocolling, interpretation and reporting of pharmacokinetic studies in animals and man. Some experience of supervising technical staff would also be desirable. The job will involve significant contact with personnel within the safety evaluation and medical functions.

We can offer excellent technical and recreational facilities situated in attractive Cheshire countryside about 15 miles south of Manchester. Our salaries and related benefits are highly competitive and generous assistance with relocation is available if appropriate.

Applications including a detailed CV should be addressed to:

ICI

The Personnel Officer (BA),
Imperial Chemical Industries PLC,
Pharmaceuticals Division, Mereside, Alderley Park,
Macclesfield, Cheshire, SK10 4TG.

Closing date for applications is 11th September 1987.

ICI is an equal opportunities employer.

Microbiologist

c. £13,500 S.E. London

... to head the operation of a small microbiology laboratory, monitoring all aspects of the production of glucose syrups.

A degree in microbiology, together with several years experience in either the Soft Drinks, Brewing or Dairy Products industry is essential.

Benefits include 4 weeks 4 days holiday, and a non-contributory pension scheme.

For an application form, please write or telephone: Personnel Department, Tunnel Refineries Ltd., Thames Bank House, Tunnel Avenue, Greenwich, London SE10 0PA. Tel: 01-858 3271.

TUNNEL
REFINERIES

MORE VACANCIES ON PAGES 2–10

SCHERING

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Schering AG, West Germany, is a major force in the chemical industry worldwide. Its subsidiaries within the UK have interests in pharmaceuticals, industrial chemicals, electroplating and chemicals for agriculture, and employ over 2,000 people in a wide range of disciplines.

The animal and public health operation of the Group is conducted by Cambridge Animal and Public Health Limited, which is responsible for the worldwide development and sale of products for the animal health, public health, vector control and rodenticides markets.

Within this operation we are seeking a Technical Executive to strengthen our vector control effort and to develop and service our animal and public health business in Latin America.

Initially, you will provide technical back-up to our vector control, animal and public health development programmes and eventually you will assume full commercial responsibility for the territory.

You should be a graduate with experience in medical entomology or parasitology and preferably have some tropical experience. A good working knowledge of Spanish is essential.

You are likely to spend about 3 months travelling overseas each year and you will need to be a self starter with sufficient social skills to be able to communicate and work effectively with your overseas collaborators.

The competitive salary is accompanied by a range of benefits including relocation assistance where appropriate.

Please send full career and salary details quoting Ref: 0029/NS to Nicola Graver, Personnel Manager,Schering Agrochemicals Limited, Hauxton, Cambridge CB2 5HU.

Schering Agrochemicals Limited is a subsidiary of Schering AG, West Germany.

SCHERING Agrochemicals

NORTHERN REGIONAL HEALTH AUTHORITY

Regional Medical Physics Department
Freeman Hospital

BASIC GRADE COMPUTER SCIENTIST/PHYSICIST/ ENGINEER

Computing and electronics have a significant role to play in the care of patients within the Health Service. Our team is currently applying these techniques in a wide range of research and development problems to improve patient care. We are looking for a keen, enthusiastic person, who is eager to develop and widen their computer education and skills. We need someone to share in the responsibilities of the computer section, and who would be willing to help co-ordinate computer planning and development within the Freeman Hospital Unit.

We invite you to contact Dr A Murray, Head of the Freeman Hospital Medical Physics Unit, to discuss any questions you might have (Tel 091 2845111 Ext 3449). We also encourage informal visits.

Applicants must possess a good honours degree in Computing Science, Electronic Engineering, Physics, or other appropriate subject.

Salary scale: £7452–£9996 (pay award pending).

Application form and job description from Regional Personnel Officer, NRHA, Walkergate, Newcastle upon Tyne NE6 4PY (Tel 091-2654138 Ext 3112).

Closing date: 4 September, 1987.

NATIONAL INSTITUTE OF AGRICULTURAL BOTANY

Head of Seed Pathology

The official Seed Testing Station, a branch of NIAB, requires a

SENIOR PATHOLOGIST

to manage a section which provides a testing service for seed borne diseases, advises industry and government, and undertakes research into new improved methods.

Applicants should have a PhD, substantial relevant postdoctoral experience, good management skills preferably demonstrated by a proven track record, and genuine wide-ranging interests across the different sectors of pathology work. Evidence of successful innovation is also sought. The age guide is 30-37, but applications from those outside this range are welcome. Salary scale from £13 294-£16 928 pa (pay increase pending).

For further particulars and application form, please telephone the Personnel Office, NIAB, Huntingdon Road, Cambridge CB3 0LE, on 0223 276381, Ext 2234, quoting ref SV/A27. Closing date: 11 September.

NATIONAL INSTITUTE FOR MEDICAL RESEARCH

Laboratory of Leprosy & Mycobacterial Research

A vacancy has arisen for a

Temporary Junior Technician

in the Laboratory of Leprosy & Mycobacterial Research, here at the Institute. The postion is available for one year and is to work on the immunological aspects of leprosy. Applicants with experience in protein separation techniques and serological analysis, and with a broad interest in the immunology in infectious diseases, would be preferred.

Salary will be in the range £4219-£5384 pa (inclusive of London Weighting) dependent on age, experience and qualifications.

The Institute is situated in pleasant rural surroundings. A staff association offers good recreational, sports and social facilities.

Please telephone for an application form on 01-959 3666, Ext 218, or write to Miss C. J. Oldham, Assistant Personnel Officer, NIMR, The Ridgeway, Mill Hill, London NW7 1AA quoting reference TT/L.

An Equal Opportunities Employer.

UNITED MEDICAL & DENTAL SCHOOLS
(St. Thomas's Campus)

NUCLEAR MAGNETIC RESONANCE CENTRE

There are two vacancies for research workers in the new Magnetic Resonance Centre:

1. **Postdoctoral Research Worker** is required to join a group studying brain metabolism. Experience either in physical biochemistry or NMR techniques is preferred but not essential. Persons with a strong metabolic background will also be considered. Salary scale: £9305-£14 825 plus £1393 London Weighting Allowance.
2. **Science Graduate** is required to take responsibility for a Bruker AM400 spectrometer in terms of both its routine operation and support services. He or she will also be involved in ongoing NMR research projects which include biochemical aspects of tumour growth with the Imperial Cancer Research Fund's Clinical Oncology Unit, and studies on cardiac and brain metabolism. Previous experience in NMR would be an advantage, but is not essential. Salary scale: £8185-£11 015, plus £1393 London Weighting Allowance. This is a re-advertisement and previous applicants need not apply.

Both posts are available for three years in the first instance. Request for further information or applications with full cv and the name of two referees to Professor H. Bachelard, Division of Biochemistry, UMDS, St. Thomas's Campus, London SE1 7EH (for the postdoctoral post), or Dr P. Garlick, Department of Radiological Sciences, UMDS, Guy's Campus, London SE1 9RT, Telephone 01-407-7600, Extension 2433 (for the graduate post), *no later than 10 September, 1987.*

BRITISH GEOLOGICAL SURVEY

Assistant Scientific Officer

The Survey has a vacancy at its office in Wallingford for an Assistant Scientific Officer to join a group working on various aspects of the chemistry of natural waters, including geothermal, water-rock interaction and acid-rain studies. Duties involve the analysis of water samples for inorganic constituents by a variety of modern techniques. The post is primarily laboratory based, but will involve some fieldwork collecting rock and water samples. It will also involve day-to-day management of the Section's hydrogeochemical database, and an interest in or aptitude for computing is desirable.

QUALIFICATIONS

Candidates must be at least 16 and under 27 years of age and have at least four 'O' level passes (or equivalent) including English Language and a mathematical or scientific subject.

SALARY

At age 16—£4004 per annum
age 17—£4585 per annum
age 18—£5250 per annum
age 19—£5618 per annum
at age 20 and over £6431 per annum rising to £7816.

Application forms, to be returned by 11 September, 1987 may be obtained from:

Establishments (Recruitment) Section
British Geological Survey
Keyworth
Nottingham NG12 5GG

or telephone 06077 6111 Ext 3110

Please quote reference ASO/WL/87/1.

Natural Environment Research Council

The Natural Environment Research Council is an Equal Opportunities employers

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BRITISH ANTARCTIC SURVEY

Physicist

The Space Plasma Physics Group of the Survey has a vacancy for a Magnetospheric Physicist to undertake research in Cambridge into the generation and propagation of certain types of plasma waves in the magnetosphere, and especially into the interaction between whistler mode waves and ultra low frequency magnetic pulsations. This will be done by studying the dynamic spectra and cross-spectra of the waves recorded by microcomputer-controlled equipment recently installed at Halley station, Antarctica.

Duties will also include the experimental and theoretical study of other types of waves recorded in space and which are under investigation within the Group. This will involve a close collaboration with other group members and the preparation of data-handling programs for the wave experiments on the European Space Agency CLUSTER satellites in which the Group proposes to participate.

The post will be for three years at HSO level.

QUALIFICATIONS: Degree in Physics and/or Mathematics, with at least two years relevant experience in computing, and preferably a higher degree in magnetospheric physics or another branch of plasma physics.

SALARY: Higher Scientific Officer (HSO) in the scale £8733-£11 765 pa.

For further details and an application form, please contact: The Establishment Officer, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET. Tel Cambridge (0223) 61188, Ext 234/235.

Please quote Ref: BAS 33/87.

Closing date for completed applications: 11 September, 1987.

Natural Environment Research Council

CAB INTERNATIONAL

The world's leading information service for scientists and technologists

CABI is a co-operative, not-for-profit organisation owned, administered and financed by 29 member country governments. We provide information, scientific and development services for agriculture and allied disciplines throughout the world.

SCIENTIFIC INFORMATION OFFICER

(Protozoology)

Applications are invited from graduates in a biological science which included some protozoology. Post graduate experience in protozoology would be advantageous and a knowledge of Spanish or Portuguese would be particularly valuable.

Duties of the post include scanning world literature on medical, veterinary and zoological protozoology; preparing and indexing abstracts for input to the CAB Abstracts database and publication in *Protozoological Abstracts*.

SCIENTIFIC INFORMATION OFFICER

(Animal Health)

Applications are invited from graduates in veterinary medicine or a relevant biological science. Post graduate experience in these fields would be advantageous and knowledge of a foreign language would be particularly valuable.

Duties include scanning world literature on veterinary sciences, preparing and indexing abstracts for input to the CAB Abstracts database and publication in *Veterinary Bulletin*.

Both Posts

The successful candidates will join our Bureau of Animal Health and will be expected to acquire a reading knowledge of at least two foreign languages.

Salary will be in the range £6973-£11 765 pa.

Our Headquarters and Information Services have recently moved into prestigious refurbished offices at Crowmarsh Gifford, near Wallingford. In addition to very pleasant working conditions, we offer a subsidised staff dining room, flexible working hours and a generous index-linked pension scheme.

Please apply in writing enclosing your cv to:

Hilda Marsden, Personnel Section
CAB International,
Wallingford, Oxon OX10 8DE

Closing date for applications Friday 11 September, 1987.

Toxicologist

A toxicologist is required to join a team studying pollutants in drinking water. The person appointed will be required to carry out critical evaluations of the mammalian toxicology of substances and to prepare advice on the basis of these evaluations.

The successful candidate must be a well qualified graduate in a biological subject, preferably with a specialisation in toxicology. An important element of the job is to deal with enquiries and an ability to communicate the complex concepts of toxicity to a wide range of non-specialists is essential. Some experience in the use of toxicity data would be an advantage. The job will require some limited travel, and a clean driving licence is required.

The salary will depend on age, qualifications and experience. Excellent conditions of employment include flexible working hours, a staff restaurant, a contributory pension scheme and 22½ days holiday.

Written applications should outline educational history, qualifications and experience to date and should be addressed to Mrs Pamela Stratford, Personnel Dept., Water Research Centre, Medmenham Laboratory, Henley Road, Medmenham, PO Box 16, Marlow, Bucks., SL7 2HD. Tel: Henley (0491) 571531, quoting Ref No. 240.

Closing date: 11 September 1987.

WATER RESEARCH WRc ENVIRONMENT

Providing Water Technology Worldwide

OPPORTUNITIES IN FOOD RESEARCH WITH RHM

for SENSORY ANALYSTS and STATISTICIANS

RHM Research and Engineering Limited provides a centre of technical expertise and consultancy for the Ranks Hovis McDougall Group which has worldwide interests in the milling, baking and grocery markets.

Due to continuing development and growth of sensory analysis and consumer research and an increasing level of statistical consultancy in research projects, we require;

SENSORY ANALYST, with a few years' experience of organising, designing and conducting food quality tests, who is familiar with the analysis and interpretation of sensory data. The candidate is likely to have a degree or equivalent in a science subject, and have the capability to lead projects at the earliest opportunity.

SENSORY STATISTICIAN, who has a practical interest in sensory/consumer studies with experience of their design and analysis. The job will involve applying new techniques in data analysis and project leadership in the sensory and consumer research programme.

STATISTICIAN, probably a recent graduate in Statistics or related subject, to advise on the design and analysis of research experiments involving process and product development, quality control and statistical process control, sensory analysis and consumer surveys.

Enthusiasm, initiative and good communication skills are important in these jobs, which require close collaboration with other project team members and liaison with RHM technical and marketing staff.

A competitive salary will be offered, dependent upon the qualifications and experience, and the terms and conditions of employment are as expected of a major UK manufacturing group.

Please apply quoting reference Q6 to:
Personnel Administration,
RHM Research and Engineering Limited,
The Lord Rank Research Centre,
Lincoln Road,
High Wycombe,
Bucks HP12 3QR.
Tel: HW 26191

RHM

RHM RESEARCH AND ENGINEERING LTD

THE CITY & HACKNEY HEALTH AUTHORITY

Gastroentrology Department

RESEARCH ASSISTANT/
POSTDOCTORAL ASSISTANT

Salary £8653-£11 187 inc.

Assistant required to work in research into the aetiopathogenesis of Coeliac Disease involving immunology and genetics. 1-2 year's laboratory experience in cellular immunology preferred. For further details please contact Dept of Gastroenterology, St Bartholomew's Hospital, West Smithfield, London EC1A 7BE or Tel 01-601 8508.

Job sharer's will be welcomed with or without a partner.

Closing date: 3 September, 1987.

Working towards Equal Opportunities.

THE SCHOOL OF PHARMACY

University of London

TRAINEE TECHNICIAN

required for work in Microbiology Laboratories. Interesting opportunity for young person with at least four 'O' levels or equivalent. Opportunity for day release for further education. Salary scale £4872-£6297 pa inc London Weighting.

Appointment for three years only.

Apply in writing with relevant details to: Assistant Secretary (Personnel), The School of Pharmacy, 29/39 Brunswick Square, London WC1N 1AX.

Graduate Research/ Computer Assistant

Epidemiology Unit, Oxford

A Graduate Research/Computer Assistant is needed to work in the Epidemiology Unit of the Imperial Cancer Research Fund in Oxford.

The duties include general administrative and clerical assistance on a wide range of studies in the area of cancer epidemiology, as well as the use of mainframe and microcomputers. Experience of computing, especially use of statistical packages would be advantageous but not essential. More important is an aptitude for numerical work and the ability to work with the minimum of supervision.

Salary range: £7082-£10 019.

Written applications, with names and addresses of two referees to Dr D. Forman, ICRF, Gibson Building, Radcliffe Infirmary, Oxford OX2 6HE.

Technician/Research Officer

St. Mark's Hospital, London EC1

The Colorectal Unit of the Imperial Cancer Research Fund is based at St. Mark's Hospital, EC1 and a Technician/Research Officer is required to assist in research aimed at early detection of colorectal cancer by screening and refining clinical and pathological methods of staging and grading the disease. Use of in-situ hybridisation and general histopathological techniques are involved.

Applicants should be qualified to HNC/Degree standard.

For further information and application form please write or telephone Mrs P. Harwood, Imperial Cancer Research Fund, Lincoln's Inn Fields, London WC2 on 01-242 0200 Ext. 2357 quoting Reference 169/R.

IMPERIAL
CANCER RESEARCH FUND

JEOL

ELECTRON MICROSCOPIST

is being sought by JEOL (UK) Ltd for their Colindale, London laboratories. Duties will include demonstration of JEOL transmission instruments to prospective customers, training users, lecturing and developing new techniques and accessories. Opportunities exist for career development, participation in current research projects and publications. The successful candidate will already have experience in operating transmission electron microscopes, particularly in a materials science environment. An attractive package of salary, pension scheme and company car is being offered.

Please apply in writing with your cv in the first instance to Dr R. Freeman, Senior Technical Manager, JEOL (UK) Ltd, JEOL House, Grove Park, Colindale, London NW9 0JN.

JEOL

CLINICAL DATA CO-ORDINATOR

Wyeth Research (UK) is part of a major international pharmaceutical company with a broad commitment to research and an impressive record of growth and development in the field of medicine and nutrition.

The Clinical Data Management Section is currently undergoing a major expansion plan to meet the growing demands for data-handling (establishing and maintaining computerised databases) in international clinical trials.

Based at UK headquarters in Taplow, near Maidenhead, the Clinical Data Co-ordinator will co-ordinate and review the assignments of a small team working on a specific product area.

Educated to HNC level in Maths, Statistics, Biology, or a related subject, candidates should have two or more years' relevant work experience and the ability to contribute at a supervisory level to the rapid and successful development of this section.

In addition to a competitive salary, related to qualifications and experience, other benefits include 24 days' annual holiday, relocation assistance if appropriate, an excellent subsidised staff restaurant, and an active sports and social club.

To apply, please send a comprehensive cv (quoting Ref: RDD/11) including details of your current salary and benefits package to:

The Personnel Department, Wyeth Laboratories, Huntercombe Lane South, Taplow, Maidenhead, Berkshire SL6 0PH. Tel: Burnham (06286) 4377 Ext.4342.

• Wyeth Research (UK)—British based research facility of Wyeth Laboratories.

• Wyeth Laboratories—wholly owned subsidiary of American Home Products, one of the world's major pharmaceutical companies.

Wyeth Laboratories

ISLINGTON HEALTH AUTHORITY
WHITTINGTON HOSPITAL, LONDON N19

Junior B Medical Laboratory Scientific Officer

To work in this well equipped Laboratory of the Biochemist Department, within our Pathology Department.

You must possess two Science A Levels or a degree acceptable to the CPSM.

Training will be given leading to State Registration and IMLS Professional Qualifications.

Whitley Council conditions of service will apply.

If you are scientifically and practically minded then apply for a Job Description and Application form from our Personnel Department, Whittington Hospital, St Mary's Wing, Highgate Hill, London N19 5NF. Tel 01-272 9679. Please quote reference No AB3(d).

Closing date: 10 September, 1987.

ENVIRONMENTAL SCIENTIST

An environmental scientist with some career experience is required by this established consultancy to complement their existing expertise in soils, ecology, field engineering and agronomy. Much of the work is concerned with environmental aspects of land developments, including those on mineral workings, disturbed and derelict land. The appointment would initially be for 12 months, but there are good prospects of a permanent position with further opportunities for advancement.

Apply with full details to G. G. Fisher:

LAND CAPABILITY CONSULTANTS LTD

Times House, Willingham, Cambridge CB4 5LH

HAMMERSMITH AND QUEEN CHARLOTTE'S
SPECIAL HEALTH AUTHORITY
HAMMERSMITH HOSPITAL

SENIOR BIOCHEMIST

Applications are invited for the above post which is based in the Immunoassay Laboratory, Department of Medicine, Hammersmith Hospital.

The Laboratory provides a Supra-regional Assay Service for peptide and gut hormones (Director, Professor I. MacIntyre).

There are excellent facilities for research and participation in research and development will be expected.

Experience in immunoassay and a postgraduate qualification in clinical biochemistry will be an advantage.

For further details please contact:

DR J. M. BURRIN
PRINCIPAL BIOCHEMIST
Telephone: 01-740 3032 (direct line)

Application form and job description can be obtained from:

DISTRICT PERSONNEL DEPARTMENT
HAMMERSMITH HOSPITAL
DU CANE ROAD
LONDON W12 0HS
Telephone: 01-740 3009 (24 hour answering service)

CLOSING DATE: 2 September, 1987.

Day nursery and season ticket loan facilities available.

WORKING TOWARDS EQUAL OPPORTUNITIES

Research Scientist–fish population dynamics
Freshwater Fisheries Laboratory, Pitlochry

The work is in a small group studying the population dynamics of Atlantic salmon in Scotland and advising the Department on the effects of fishing, predation and environmental change on stocks and catches. It requires a combination of mathematical and biological skills, including an ability to construct mathematical models of biological events. Providing clearly-expressed scientific advice to lay administrators will form the major part of your work. You may occasionally be required to undertake periods of research at sea aboard research and commercial fishing vessels.

You should have a good honours degree in an appropriate subject and a minimum of four years' research experience in a numerate discipline including familiarity with computing and statistical methods. Biological knowledge is desirable but not essential.

Salary: £11 557–£20 292 depending on qualifications, experience and level of appointment.

For further details and an application form (to be returned by 11 September, 1987) write to Scottish Office, Personnel Division, PM (PTS) 3, Room 208, 16 Waterloo Place, Edinburgh EH1 3DN.

Please quote Ref: S/7305.

SCOTTISH OFFICE

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Link
ANALYTICAL

SALES ENGINEER, NUCLEAR INSTRUMENTATION

Link Analytical Ltd, world leaders in X-Ray Microanalysis Instrumentation require a Sales Engineer to promote a new and exciting range of Nuclear Instrumentation products. Candidates should be educated to Degree level or equivalent and a working knowledge of gamma ray spectrometry would be an advantage.

The position involves extensive travel both within the UK and abroad.

An attractive salary, company car and the usual fringe benefits associated with a large international company are offered.

Please apply in writing to:

Mr R. A. Jones,
Marketing Director,
Link Analytical Ltd,
Halifax Road, High Wycombe,
Bucks HP12 3SE

A MEMBER OF THE UEI GROUP

MORE VACANCIES ON PAGES 2–10

BARNET HEALTH AUTHORITY

Edgware General Hospital

JUNIOR 'B' MEDICAL LABORATORY SCIENTIFIC OFFICER/MLSO

Required for either Histology or Cytology. We can also arrange a rotation between the two if so desired. A wide based training will be given including day release and the successful candidate will be encouraged to proceed to the Special Examination for Fellowship of the IMLS.

Candidates applying for the Junior 'B' post should hold ONC or Medical Laboratory Sciences or an appropriate Science degree or have two Science 'A' levels including Chemistry. Those applying for the MLSO post should hold a BTec in Medical Laboratory Sciences. Salary: Junior 'B' £4727-£6306 pa. MLSO £7086-£9704 pa. (Both inclusive of London Weighting).

Please state whether you are interested in the Junior B or MLSO post.

Job description and application form available from Personnel Department, Edgware General Hospital, Edgware, Middx HA8 0AD.

Closing date: 4 September, 1987.

DEPARTMENT OF MICROBIOLOGY & PHLS LABORATORY

University Hospital, Nottingham

RESEARCH ASSISTANT

Applications are invited from graduates with a first or second class honours degree in microbiology or an allied subject to assist with a MAFF-funded project investigating the use of DNA probes for the detection of food-borne pathogens and toxins. Some experience of DNA hybridisation techniques would be an advantage.

The post is tenable in this integrated University/PHLS department for up to three years on the scale £7452-£7716-£8004 (under review). Applications (cv, details of experience and names of two referees) to Dr K. J. Towner, Department of Microbiology & PHLS Laboratory, University Hospital, Nottingham NG7 2UH, from whom further details may also be obtained (0602-421421, Ext 3453). Closing date 7 September, 1987.

UNIVERSITY OF GLASGOW

Departments of Biochemistry and Botany

POSTGRADUATE RESEARCH ASSISTANTSHIP

Applications are invited for the above post, tenable from 1 October, 1987 for three years, to work on the regulation of phosphoenolpyruvate carboxylase in Bryophyllum fedtschenkoi by phosphorylation. The project is financed by an AFRC grant to Dr H. G. Nimmo and Prof C. A. Fewson (Dept of Biochemistry) and Prof M. B. Wilkins (Dept of Botany) and will follow up the work published in Biochem. J. 239 213-220 (1986) and Planta 170 408-415 (1987). The salary will be at an appropriate point on Scale 1B. Registration for a higher degree will be possible. Applicants should have a good Honours degree in Biochemistry, or a related subject and an interest in enzyme regulation.

Applications, including a cv and the names of two referees, should be sent as soon as possible to Dr H. G. Nimmo, Department of Biochemistry, University of Glasgow, Glasgow G12 8QQ, from whom further details can be obtained. Tel 041-339 8855, Ext 4721.

THE LONDON HOSPITAL MEDICAL COLLEGE

(University of London)

RESEARCH ASSISTANT, DRUG ANALYSIS

Applications are invited from graduates in biochemistry, pharmaceutical science or pharmacology with not less than three years research experience in HPLC and related chromatographic analytical techniques. The work is under the terms of a Wellcome Trust Grant and involves the analysis of drugs and metabolites in the analgesic field.

Salary: £8185 plus £1393 London Weighting pa. (Researcher IB scale).

Applications to the Secretary, The London Hospital Medical College, Turner Street, London E1 2AD within 14 days of this advertisement.

Enquiries to Prof Vere, Department of Pharmacology and Therapeutics (Tel 01-377 7105).

UNIVERSITY OF NOTTINGHAM

Department of Biochemistry

RESEARCH TECHNICIAN IN MOLECULAR NEUROBIOLOGY

Applications are invited from men and women to join a research team using recombinant DNA techniques and characterise human gene sequences encoding proteins associated with specific brain diseases.

Minimum qualifications HNC or equivalent with experience in one or more of the following techniques: growth manipulation of bacteriophage and plasmids, oligonucleotide screening of gene libraries, Southern blot hybridisation, restriction mapping, DNA sequencing.

Current salary scale, under review, from £6368-£8986 pa for a 5-day, 37 hour, working week.

This is a research funded post which will be initially offered for a period of 15 months. Apply in writing enclosing full cv, including the names of two referees, to Dr M. A. Billett, Department of Biochemistry, University Medical School, Queens Medical Centre, Nottingham NG7 2UH. Additional information available on 0602-421421.

UNIVERSITY OF BRISTOL

Department of Physical Chemistry

POSTDOCTORAL RESEARCH ASSISTANT

required immediately to work on a two-year SERC-funded project to investigate electron-molecule collisions. We have been using an electron source of energy resolution <5 meV to study low energy scattering of electrons from supersonic molecular beams of O_2 and other molecules. This experiment, sited at the Daresbury Synchrotron Radiation Laboratory, is yielding exciting new data and offers experience in the use of synchrotron radiation, electron optics and molecular beams. Salary starting at £9865 pa.

Applications from both physicists and chemists to be sent with a cv plus names and addresses of two referees to Dr D. Field, School of Chemistry, University of Bristol, Cantock's Close, Bristol BS8 1TS.

THE POLYTECHNIC, WOLVERHAMPTON

RESEARCHER POSTS

Applications are invited for two Researcher A posts starting in October 1987 to work on the following projects:

(E17) Analysis of Product Quality in Major Arable Crops

The Researchers will join the Crop Analysis Research Group working in the School of Applied Science. The main aim of the research programme will be to develop and apply techniques for the detailed analysis of changes in product quality of major arable crops arising from field applications of agrochemicals and nutrients which have potential for commercial exploitation. The research will expand existing studies on product quality in winter wheat and sugar beet.

Applicants should have, or expect to gain, a good honours degree in Biological Science, Agricultural Science, Biochemistry or a related discipline. A particular interest in, or experience of, biochemical or chemical analysis would be an advantage.

The Researchers will be appointed for one year initially, renewable for two further years, and will be expected to register for a higher degree. Salary will be on the Researcher A scale £6845-£7641. For further information contact Dr T. J. Hocking, School of Applied Sciences (0902 313001, Ext 2158).

Closing date: 3 September, 1987.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

(University of London)

POSTDOCTORAL RESEARCH ASSISTANT

Applications are invited for a Postdoctoral Research Assistant on the scale £10 698-£16 218, funded for four years by the science and Engineering Research Council to work with Prof W. J. Albery, FRS on the development of electrochemical biosensors.

Applications including a cv and the names of two referees should be sent a soon as possible to: Prof W. J. Albery FRS, Department of Chemistry, London SW7 2AY.

OCCUPATIONAL HYGIENTISTS

CASELLA

Casella Environmental Services is the consultancy arm of the UK's major manufacturer of air sampling equipment. We provide technical support to clients, and arrange of services including asbestos project management from NATLAS laboratories, COSHH audits, food hygiene advice supported by a microbiology lab, and all other aspects of environmental problem solving.

Senior Occupational Hygienist to £14 000

A qualified person with sound practical experience of general occupational hygiene. Responsibilities: management of projects in all fields, including asbestos, and supervision of staff.

Occupational Hygientist to £11 000

A qualified person with one or two years experience. The package includes the benefits of a major company: car, non-contributory pension scheme, subsidised staff restaurant, 25 days holiday pa.

Please apply with cv to: Bill Sanderson, Regent House, Britannia Walk, London N1 7ND.

Closing date: 1 September, 1987.

The Consultancy with the Authority.

PIONEER®

PLANT BREEDER

Required to manage a new research station in France. Activities will include the development of a breeding and testing programme for rapeseed and close interaction with relevant biotechnology research groups in Europe.

Applicants should have a PhD or equivalent degree in plant breeding and genetics, and preferably also have experience in rapeseed breeding. An ability to communicate in French and English will be an advantage.

Letters of application, together with cv and names of three referees, should be sent to Dr I. B. Edwards, Pioneer Overseas Corporation, 6800 Pioneer Parkway, PO Box 316, Johnston, Iowa 50131 USA.

FATS TECHNOLOGIST

RHM Research and Engineering Limited is the central research and engineering facility of the Ranks Hovis McDougall Group of Companies. The Group's activities include the manufacture and distribution of a wide range of food products in the milling, baking and convenience food sectors.

As a result of expansion in the Food Science Department at RHM RE, a Fats Technologist is required to work on all aspects of oils and fats in food systems.

This is a growing area within the Research Centre and the job offers the opportunity to further exploit this key area of food science. As a member of a developing group you will be involved in the planning of projects, laboratory studies and the application of the results at factory sites.

You will be expected to lead projects at an early stage and hence self-motivation and initiative are prime requirements. As a project leader, good communication and organisational skills will be vital.

You will require a fundamental understanding of fats in food systems in conjunction with a sound technical background of the chemistry of fats.

For this challenging role you will need a good degree in a science subject with 2–4 years' experience of the technical aspects of fats and oils in food systems.

A competitive salary will be offered, together with excellent terms and conditions of employment as expected of a major company.

Please apply quoting reference 316 to:

Personnel Administration
RHM Research and Engineering Limited
The Lord Rank Research Centre
Lincoln Road, High Wycombe, Bucks HP12 3QR
Tel: High Wycombe 26191

RHM

RHM RESEARCH AND ENGINEERING LTD

Graduate Pharmacologist For Thrombosis Research

Beecham Pharmaceuticals, a highly successful British Company with an outstanding record of discovery and development of ethical pharmaceuticals, are continuing to expand and have a vacancy for a highly motivated recent graduate to join an internationally renowned group working on new methods for treating heart disease.

The person appointed will work with a team involved in the evaluation of novel thrombolytic agents in small laboratory animal models of thrombosis and so candidates must have an aptitude for animal work and will also be required to perform some *in vitro* biochemical tests to complement the *in vivo* work.

Applications are invited from graduates with at least an upper second class honours degree seeking a career in research.

Starting salaries are very competitive and the benefits from a highly successful British company include non-contributory pension, life assurance, an active sports and social club, and flexible working hours in a very pleasant environment.

For an application form please write to the **Personnel Manager, Beecham Pharmaceuticals Research Division, Biosciences Research Centre, 1 Yew Tree Bottom Road, Epsom, Surrey or telephone our 24 hour answering service on Burgh Heath (073 73) 63457.**

Beecham
Pharmaceuticals

UNIVERSITY OF LEICESTER
School of Medicine
TECHNICIAN GRADE III

A vacancy exists in the Department of Pharmacology and Therapeutics for a Technician Gr III to work on a project investigating the molecular basis of the effects of adensine on insulin action in skeletal and cardiac muscle. This post is of three years duration funded by the Wellcome Trust. Experience in basic biochemical techniques is essential; practical experience in cell culturing techniques would be advantageous, but not essential.

The minimum requirements for this position are ONC/OTEC or equivalent and three years relevant laboratory experience. **Salary: £6314-£7448 pa.**

Full application in writing to the Chief Technician, Department of Pharmacology and Therapeutics, Medical Sciences Building, University of Leicester, University Road, Leicester LE1 7RH, from whom further details of the post may be obtained.

ASHBOURNE TUTORS

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WE HAVE SOME FULL-TIME
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Write with cv and telephone number, or contact directly the Vice Principal, Ashbourne Tutors, 59-61 Kensington High Street, London W8 5EQ. Telephone: 01-937 3858

HAMMERSMITH AND QUEEN CHARLOTTE'S SPECIAL HEALTH AUTHORITY

HAMMERSMITH HOSPITAL

ELECTRONICS TECHNICIAN REQUIRED FOR THE DEPARTMENT OF SURGERY

To be responsible for the maintenance and operation of electronic recording equipment for the Theatres and Intensive Care Unit. Salary, on scale MPT III, £8306 to £10 385 inclusive of London Weighting.

Informal enquiries would be welcomed by Mr K. Hallows on 01-743 2030, Ext 4583.

Application form and job description can be obtained from:

District Personnel Department,
Hammersmith Hospital,
Du Cane Road, London W12 0HS.
Tel 01-740 3009 (24 hour answering service)

Day nursery facilities are available.

Closing date: 2 September, 1987.

Working towards Equal Opportunities.

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Got a science degree or lab experience? Looking for a more exciting way of capitalising on your scientific training? You could take the first step into a highly successful career in sales and marketing by becoming a scientific or medical rep. It's a tough job, but the rewards for success are high; if you're ambitious and self-motivated, phone or write for our free information brochure NOW:

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01-229 4214
Freepost, London W2 1BR.

INSTITUTE OF PSYCHIATRY
ANIMAL TECHNICIAN

Required to work with all species in the central animal house. Some previous relevant experience, especially in record keeping and breeding is essential.

Salary range (Whitley Council) £4009-£5588 pa plus £1201 London Weighting.

Application forms can be obtained from the Assistant Secretary, Institute of Psychiatry, De Crespigny Park, London SE5 8AF.

Closing date: 10 September, 1987.

TRENT POLYTECHNIC
School of Science

RESEARCH ASSISTANT/ DEMONSTRATOR

(£6843-£7641 pa pay award pending)

A research assistantship is available for studies on *'In Vitro'* production and multiplication of sugar beet.

Candidates should possess a good honours degree with plant physiological emphasis and preferably have some experience of plant tissue culture work. Candidates with a background or experience in agriculture may have an advantage.

Further details and form of application are available from the **Staff Officer, Trent Polytechnic, Burton Street, Nottingham NG1 4BU. Tel (0602) 418248, Ext 2148.** Closing date 4 September, 1987. Please quote post number X0014.

PUBLIC HEALTH LABORATORY SERVICE BOARD

PHLS Centre for Applied Microbiology & Research

Microbial Technology Laboratory (Protein Engineering Programme)

MOLECULAR GENETICIST

For a major research programme in protein engineering.

You will be required to undertake site directed mutagenesis of cloned genes encoding proteins of scientific and commercial interest. You will also be concerned with the development of novel expression vector systems to enable the regulated, high expression of engineered proteins in various micro-organisms.

You will be involved in cloning and characterisation of novel genes from a variety of organisms and the studies undertaken will to a large extent be interchangeable, allowing the acquisition of expertise in many of the techniques currently utilised by the molecular biologist. You should possess a degree (or equivalent) in a relevent biological discipline. Related postgraduate research experience an advantage, but not essential.

Salary scale: £6660-£9360 pa (Basic Grade Microbiologist).

For further information contact Dr N. Minton, Idmiston (0980) 610391, Ext 562.

NHS terms and conditions of service.

Application forms from the Personnel Officer, PHLS Centre for Applied Microbiology and Research, Porton Down, Salisbury, Wiltshire SP4 0JG.

Quote post number 0985.

Closing date: 11 September, 1987.

UNIVERSITY OF LIVERPOOL

National Clay Tobacco Pipe Stamp Catalogue

Applications are invited for the post of

POST-DOCTORAL SENIOR RESEARCH ASSISTANT

to work on a data base financed by a grant from the Leverhulme Trust to the Department of Continuing Education. A knowledge of post-mediaeval archaeology is essential.

The post is tenable for up to three years at an initial salary of £9305 pa.

Applications, together with the names of three referees, should be received not later than 11 September, 1987, by the Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained.

Quote Ref RV/593/NS.

An Equal Opportunity Employer.

The International Autistic Research Organisation

One Day Conference, Friday, 11 September, 1987. Research in Autism. Held by Dr Bernard Rimland, California at St Lawrence's Hospital, Caterham, Surrey.

Further information: 01-777 0095 or 0883 46411, Ext 48.

South Pacific Commission

Tuna and Billfish Assessment Programme

PROGRAMME COORDINATOR

The Tuna and Billfish Assessment Programme is responsible for conducting research on pelagic fish stocks in support of fisheries producing US$300,00,000 in landed revenues. These stocks are the most valuable renewable resources in a region of 30,000,000 square kilometres in the central Pacific Ocean. The Tuna Programme consists of nine professional and five support staff with an annual budget of US$700,000.

The Programme Coordinator position is vacant, The incumbent to this post is responsible for planning and supervising activities of the Programme according to research priorities established by the SPC. An established fisheries biologist with international experience is sought. Location of the post is at SPC headquarters in Noumea, New Caledonia. The SPC offers renewable contracts with two year tax-free salaries and comprehensive benefits. Commencing salary is from 444,616 to 505,366 cfp per month (111cfp ≃ US$1.00).

Potential candidates should respond (telex: SOPACOM 3139NM; Fax: 687-62 28 18) and send letter of application and cv to: Secretary General, South Pacific Commission, B.P. D5, Noumea Cedex, New Caledonia prior to 1 September 1987.

ISLINGTON HEALTH AUTHORITY

Whittington Hospital

Department of Chemical Pathology

BASIC GRADE PHARMACISTS

In the Department of Chemical Pathology, which provides a comprehensive clinical chemistry service and has a small but active research section. In addition to contributing to the routine service you will be encouraged to study for a higher qualification.

A further locum basic grade biochemist post is available for a period of eight months from 1 September, 1987, to cover maternity leave.

Salary for appropriate science degree with 1st or 2nd class honours: £8653-£10 561 inclusive.

Application forms are obtainable from the Personnel, Whittington Hospital, Highgate Wing, Dartmouth Park Hill, London N19 5NF. Tel 01-272 9679, ref AB123.

Closing date: 10 September, 1987.

UNIVERSITY OF BRISTOL

Department of Ophthalmology

PART-TIME (4 SESSIONS PER WEEK) TECHNICIAN GRADE 4

required for a period of 12 months to work on a project involving the Evaluation of Preferential Looking (PL) as a vision test in children with eye disease. The successful candidate, who should have an interest in visual psychophysics, children and computers, will join a research team of a Consultant Senior Lecturer, Research Associate and a Research Orthoptist. PL is a well-tried laboratory method of estimating infant visual acuity. We are interested in how well it can be translated into clinical use by Orthoptists, Doctors and other staff. We are comparing a printed card system with a computerised system. Further details from Mrs J. Bartlett, Department of Ophthalmology, Tel 233060, Ext 7619. Salary for this post within range £2856-£3306 pa.

TPL

Assistant Plant Breeder

Twyford Plant Laboratories is one of the leading companies in the field of plant biotechnology. It is part of an expanding international group with a progressive outlook.

A vacancy now exists for an Assistant Plant Breeder to join the Company at its Plant Breeding and Trials Centre, based near Leicester. The Centre, is involved with a range of vegetable and ornamentel crops, and the current position is with the brassica breeding group.

Responsibility will centre on working in a small team, developing new vegetable varieties.

The opportunity will be of interest to graduates in Agriculture/Horticulture/Botany or a related subject looking for their first appointment. Experience in field trials work would be an advantage.

An attractive salary, pension and life assurance scheme will be offered to the successful applicant.

Applications, including a cv and the names and addresses of two referees should be sent by the 7 September, to: Jane Penton, Personnel Manager, Twyford Plant Laboratories, Ham Street, Baltonsborough, Glastonbury, Somerset BA6 8QG.

JOHN INNES INSTITUTE

Department of Virus Research

POSTDOCTORAL RESEARCH SCIENTISTS

GRADUATE ASSISTANT

Two Postdoctoral Research Scientists and one Graduate Assistant required for a three year project funded by the Rockefeller Foundation on the molecular biology of rice tungro viruses. Experience in molecular biology and/or biochemistry is desirable. Further particulars can be obtained from Dr R. Hull at the John Innes Institute.

Staff will be appointed on university scales: Postdoctoral Scientists from £9305 pa and the Graduate Assistant from £8185 pa.

Applications including cv and the names of two referees should be sent to the Personnel Officer, John Innes Institute, Colney Lane, Norwich NR4 7UH, UK, to arrive not later than 11 September, 1987.

THE UNIVERSITY OF SHEFFIELD

Department of Civil and Structural Engineering

RESEARCH ASSISTANT

Applications are invited for the above post, to work on a sponsored project to investigete the impact of ultra high velocity low density jets on various forms of barrier. This work is part of a research programme into meterial behaviour and structural response to high retes of strain thet has been continuing in the department for several yeers. Special laboratory facilities are available with trained staff and high speed data recording end photographic equipment. Candidates should have a good honours degree in engineering or science and those suitably qualified may register for a higher degree.

The appointment is expected to be for three years and the initial salary will be on Range IA for Research end Analogous staff £9305–£11 015 pa (which rises on 1 March, 1988 to £9865–£11 680 pa), according to age, qualifications end experience, with yeerly scale increments and will include USS superennuetion benefits.

Further details can be obtained by phoning Dr A. J. Watson, 0742-768555, Ext 5059. Written epplications with cv end the names and addresses of three referees should be sent to the Personnel department (Academic staffing), The University, Sheffield S10 2TN before 4 September, 1987. Please quote reference R661/H

An equal opportunity employer.

SOUTH GLAMORGAN HEALTH AUTHORITY

National Blood Transfusion Service (Wales)

MEDICAL LABORATORY SCIENTIFIC OFFICER (Computing)

A state registered MLSO with a background in Blood Transfusion / Haematology / Immunology is required by the Data Processing Department. The work will include various projects involving the use of micro computers in the Virology, Quality Control and Tissue Typing Laboratories. Experience in BASIC programming essential.

Informal enquiries to Dr A. Beal, Tel 0222-890302.

Application forms and job description available from the Assistant Administrator, Welsh Regional Transfusion Centre, Rhydlafar, St Fagans, Cardiff CF5 6XF.

Closing date: 10 September, 1987.

VETERINARY MEDICINES REGISTRATION

REGISTRATION CO-ORDINATOR

To assist in the ongoing review of veterinary medicines we require a confident self-starter to assist in the production and assessment of data necessary to support our medicines registration. Reporting to the Product Development Director, the successful applicant will be qualified to degree level in pharmacology, pharmacy or a related biological science. The varied work will involve completion of data, report writing, co-ordination of field trials and liaison with scientific and marketing colleagues.

C-Vet are an exclusively veterinary pharmaceutical team and this position whilst for an initial two year period, may lead to permanent employment.

Please apply in the first instance for an application form to: Mrs Stephanie Jackman, C-Vet Limited, Minstar House, Western Way, Bury St Edmunds, Suffolk IP33 3SU.

PORTSMOUTH AND SOUTH EAST HAMPSHIRE HEALTH AUTHORITY

Saint Mary's Hospital, Milton Road,
Portsmouth, Hants PO3 6AD

TEMPORARY RESEARCH TECHNICIAN

We require a graduate or equivalent to join a small Research Team, to work on a project designed to investigate the role and interaction of vaso active hormones in kidney disease and hypertension in man. A knowledge of HPLC or radioimmunoassay would be an advantage. The project is funded for two years. Salary £5114-£5272. Those wishing to visit the Department should telephone Dr Raman's Secretary on Portsmouth (0705) 822331, Ext 3114. Application form available from the Personnel Department on Portsmouth 866480.
Closing date: 31 August, 1987.

UNIVERSITY OF BRISTOL

Applications are invited for a post of

POSTDOCTORAL SCIENTIST

to work on a project with Professor P. A. Dieppe and Dr C. J. Elson, concerned with the identification of radioimmunoassay for a novel inhibition of hydroxyaphthite chrystalisation. The post is for two years in the first instance supported by the Nuffield Foundation.

Applicants should have a background in Biochemistry/Immunology.

Applications to Professor P. A. Dieppe, Department of Medicine, Bristol Royal Infirmary by 31 August to 10 September.

UNIVERSITY OF OXFORD
Department of Experimental Psychology

RESEARCH ASSISTANTSHIP

in physiological psychology

To investigate brain mechanisms of learning and memory in non-human primates. The post is available for two years from 1 November, 1987. Appointment will be on Scale 1A (£9305-£14 825 pa) for candidates with PhD, or on scale 1B (£9305-£12 605 pa) for candidates with first degree. Interest or experience in behavioural experimentation would be an advantage. Write with full cv and the names of two referees to **Dr D. Gaffan, Experimental Psychology, South Parks Road, Oxford OX1 3UD.**

Directorship of Arthritis & Rheumatism Council Epidemiology Research Unit

ARC ARTHRITIS & RHEUMATISM COUNCIL FOR RESEARCH

The Arthritis & Rheumatism Council for research in Great Britain and the Commonwealth is seeking a new Director of its Epidemiology Research Unit, currently based in the University of Manchester Medical School. This is a replacement for Professor Philip Wood.

The activities of the Unit, which presently comprises approximately twenty scientific, technical and adminstrative staff, are concerned with a variety of aspects of the epidemiology of the rheumatic diseases.

Applications are invited from suitably qualified persons, who would be expected to have a background of epidemiology, preferably in relation to rheumatology and have a proven research record.

Further details may be obtained from the Deputy Secretary, The Arthritis & Rheumatism Council, 41 Eagle Street, London WC1R 4AR, UK. Applications should be returned to the above address by Monday 16 November, 1987.

QUEEN'S UNIVERSITY

at Kingston

Faculty Positions in Materials Engineering

Applications are invited for two tenure-track appointments and a term position.

Research/industrial experience in one or more of the following fields would be most desirable: hydrometallurgy/materials processing, surface science/materials protection, advanced materials design/microstructure engineering, composites, mathematical modelling, heat and mass transport.

Applicants should have a doctorate and a commitment to excellence in teaching and research. They should hold, or be prepared to attain PEng status. Candidates of either sex are equally encouraged to apply: duties will include the development and teaching of undergraduate and graduate courses in some field of materials science and engineering and appropriate research activity.

Salary and rank will be commensurate with qualifications and experience and it his hoped that at least one of the positions would be at a senior level for an individual with well-proven excellence. The starting date would be negotiable.

In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. Applicants should send a detailed cv, and the names of three referees to:

Professor Reginald Smith, Head
Department of Metallurgical Engineering
Queen's University at Kingston
Kingston, Ontario K7L 3N6
Tel 613-547-2657

as soon as possible and not later than 30 September, 1987.

THE UNIVERSITY OF WARWICK

Department of Biological Sciences

RESEARCH POSTS in ERWINIA GENETICS and MOLECULAR BIOLOGY

Several research positions are available on projects investigating the genetics and molecular biology of plant pathogenicity and extracellular enzyme secretion mechanisms in the Gram-negative, phytopathogenic bacterium *Erwinia*.

Postdoctorial Fellowships. Two fellowships are available to investigate the molecular mechanisms of enzyme secretion in *Erwinia carotovora*. The projects involve use of gene and protein fusions, DNA cloning and sequencing, cellular localisation studies, enzyme assays (pectinase, cellulase and protease), and mutagenesis studies. Applications from candidates with skills in enzymology or bacterial genetics or recombinant DNA work would be especially welcome. However, appropriately-motivated applicants from other biological fields will be considered, as training can be provided. Applicants should have, or very shortly expect to have, a PhD. One post is available any time after 1 October, 1987 and the other post is available from 1 January, 1988. Both appointments are for three years. Salary will be on the Research IA scale: £9305–£15 720 pa (Ref. PDF/GPCS/F).

Research technician. A graduate research technician is required to work on aspects of *Erwinia* pathogenicity. The project involves general microbiological techniques, enzyme assays, recombinant DNA work and bacterial genetics. The post is available from October 1987 and is for two years. Salary will be on the Research Technician Grade 3 scale: £6314–£7448 pa (Ref. TG3/GPCS/F).

Postgraduate PhD research studentship. A research studentship is available from October 1987 (or as soon as possible thereafter) on a project entitled *Genetic analysis of the potato pathogen, Erwinia.* The project will involve genetic engineering techniques and a wide range of molecular genetic tools (transposon mutagenesis with λ vectors; gene and protein fusions; use of phages and bacteriocins etc.) to investigate enzyme structural genes and other pathogenicity determinants of this potato pathogen. This is a SERC/CASE studentship in association with Dr M. Perombelon of the Scottish Crop Research Institute, Dundee—where the plant pathological studies will be conducted. Candidates should have at least an upper second class honours degree in microbiology, biochemistry, genetics, molecular biology or another appropriate biological science (Ref. PGS/GPCS/F).

Application forms and additional information from the Executive Officer, Department of Biological Sciences, University of Warwick, Coventry CV4 7AL (0203 523517), quoting the appropriate reference.

MORE VACANCIES ON PAGES 2–10

THE ROYAL SOCIETY

GUEST RESEARCH FELLOWS

The Council of the Royal Society invites applications for the support of Guest Research Fellows. The object of this scheme, established in 1980, is to assist outstanding leaders in scientific research in the United Kingdom to invite as guests scientists of proven ability, normally resident overseas, to come and work with them for periods of between four months and one year. The aim is to provide for research needs which can best be met by such international collaboration, and proposed guests should be key workers, normally already holding established posts, who would bring unique expertise to their hosts in the United Kingdom. Emphasis in selection will be on the abilities and field of research of the applicant working in the United Kingdom and on those special contributions to the applicant's research which would be provided by the visitor and are not available in the United Kingdom.

Applicants must be working in departments of science (including agriculture, medicine, mathematics, engineering and technology) in universities or research institutions in the United Kingdom. Direct applications from intending guests from overseas are not acceptable.

Applications should be made on forms to be obtained from the Executive Secretary (LUM), The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG, and returned by 31 October, 1987.

LUDWIG INSTITUTE FOR CANCER RESEARCH

Cambridge Branch

MOLECULAR BIOLOGIST

A vacancy exists in a group studying the molecular biology of tropomyosin and tropomyosin-containing oncogenes. The post, which is available for 12 months, could be filled at the technical, research officer or post-doctoral level. Salary is dependent upon qualifications and experience. Previous training in molecular biology would be advantageous. Further information is available from Dr A. R. MacLeod (0223) 211367.

Applications comprising a cv and names of two referees should be addressed to: The Administrator, Ludwig Institute for Cancer Research, MRC Centre, Hills Road, Cambridge CB2 2QH.

Analytical Chemists move into sales

Up to £12 000 + package

We have a number of exciting and rewarding positions for chemists in the sales field. If you have knowledge of chromatography/separation technology/spectrophotometry, and are ambitious with a commercial bias, then call us now on:
01-222 6334/1547 (24hrs)

Ross Warren Recruitment

THE MACAULAY LAND USE RESEARCH INSTITUTE—ABERDEEN

Department of Soil Survey

Two-year Term Contract

HIGHER SCIENTIFIC OFFICER

The Macaulay Land Use Research Institute has received an award, under the Department of Agriculture and Fisheries for Scotland Increased Flexibility Scheme to investigate the relationships between agriculture and forestry in Scotland. Applications are invited for a Higher Scientific Officer to work with a joint MLURI/School of Agriculture team. The post involves modelling of agricultural and forestry potentials and relating these to present and expected income flows within Scotland.

Candidates should possess a First or Second Class honours degree in an appropriate subject or subjects with at least two year's postgraduate experience in agricultural, forestry or land use research. A knowledge of computer modelling is desirable and a current driving licence is essential. Salary £8733-£11 765 pa according to experience. Non-contributory superannuation scheme operative. MLURI is an Equal Opportunities Employer.

Forms of application and further particulars may be obtained from The Secretary, The Macaulay Land Use Research Institute, Craigiebuckler, Aberdeen AB9 2QJ, to whom they should be returned by 7 September, 1987. Quote Ref IFS/MA2/87.

UNIVERSITY OF DURHAM

Department of Chemistry

Postdoctoral Post in Theoretical Chemistry

Applications are invited for an SERC Postdoctoral

SENIOR RESEARCH ASSISTANTSHIP

tenable for two years from 1 October, 1987, or later, to work with Dr J. M. Hutson on the dynamics of floppy molecules and molecular clusters. Applicants should have a strong background in theoretical chemistry or chemical physics, with experience of computational methods.

Initial salary £9305 or £9865 pa on Grade 1A with superannuation.

Applications (three copies) naming three referees (quoting Ref C1) by 14 September, 1987, to The Registrar, Science Laboratories, South Road, Durham DH1 3LE, from whom further particulars may be obtained.

Nature Conservancy Council
South Wales Region

CASUAL SCIENTIFIC DATA COLLATION OFFICER

Applications are invited for the above post to collate ecological information prior to computer processing

The contract is for six months, commencing October 1987 and will be based at the Cardiff Regional Office.

Candidates should possess a degree in a Natural Science. Experience of survey work is essential and a familiarity with both computers and nature conservation an advantage.

Salary ranges from £6711 pa

Application forms and further details from D. Isgrove, 43 The Parade, Roath, Cardiff CF2 3UH. Tel (0222) 485111.

The closing date for completed applications is 4 September, 1987.

The NCC is an Equal Opportunities Employer

UNIVERSITY OF NEWCASTLE UPON TYNE

UNIQUE ENGINEERING OPPORTUNITIES IN TWO PHASE FLUID DYNAMICS

Supported by a Teaching Company Scheme, an Associate is required for a challenging and rewarding position concerned with the development of an innovative separation device with exciting and considerable opportunities in Biotechnology, food and effluent processing. Domnick Hunter Filters Ltd, world leaders in compressed gas filtration, offer first class opportunity, prospects for advancement and conditions of work. Backed up by extensive technical and R&D facilities, the Associate will enjoy a rewarding and satisfying two year collaboration with both the University and the Company, and normal employment with the latter will be envisaged for a suitable Associate at the conclusion of the scheme.

A good honours degree in an appropriate Science/Engineering discipline and a preferred interest in Fluid Dynamics and Project Management is required. Appropriate professional training by short courses will be provided.

Starting salary will be in the range £9000-£11 000 pa depending on age and experience based on the Range 1B scale £8185-£11 015 pa with supplementation by the company for exceptional candidates. The post is funded in part by the SERC/DTI Teaching Company Scheme.

Tel Dr T. Frost, Department of Mechanical Engineering, 091 232 8511 Ext 2209/2204 for further details, or write to Senior Assistant Registrar (Establishments), The University, 6 Kensington Terrace, Newcastle upon Tyne NE1 7RU, with whom applications (two copies) with the names and addresses of three referees should be lodged no later than 1 September, 1987.

MRC Clinical Research Centre
(Northwick Park Hospital)
Watford Road, Harrow
Middx HA1 3UJ

TECHNICIAN

Applications are invited from graduates, preferably in the Life Sciences, for a technical post within a small group investigating the Cellular Electrophysiology/Neuropharmacology of High Pressure and Anaesthetic Action. Salary will depend on previous experience and will be within the range £7086–£9704 (pay award pending).

Informal enquiries may be made to Dr K. T. Wann 01-864-5311 Ext 2621.

Application forms and further details may be obtained from the Personnel Dept. Ext 2673. Quoting Ref: 101/2/3965.

Closing date for completed application forms 10 September, 1987.

The Medical Research Council is an equal opportunity employer.

INSTITUTE OF MINING AND METALLURGY

LIBRARY AND INFORMATION SERVICES

INFORMATION SCIENTIST/LIBRARIAN

The Institute provides information and library services to the International Minerals Industry. In addition to traditional library services, an abstracts bulletin and a computerised database are produced.

There will be two temporary positions for qualified Library/Information specialists, one immediately and the other in the next two months. Experience in a specialist information unit will be an advantage. The first position requires a science graduate to prepare and process data for computerisation. For the second, experience in acquisition, accessions and the running of library services is required.

To apply, please write, with cv, to:

M. McGarr,
Head, Library and
Information Sevices,
Institute of Mining and
Metallurgy,
44 Portland Place,
London W1N 4BR.

ISLINGTON HEALTH AUTHORITY

Whittington Hospital, London N19

JUNIOR B MEDICAL LABORATORY SCIENTIFIC OFFICER

To work in this well equipped Laboratory of the Biochemist Department, within our Pathology Department.

You must possess two Science A Levels or a degree acceptable to the CPSM.

Training will be given leading to State Registration and IMLS Professional Qualifications.

Whitley Council conditions of service will apply.

If you are scientifically and practically minded then apply for a Job Description and application form from our Personnel Department, Whittington Hospital, St Mary's Wing, Highgate Hill, London N19 5F. Tel 01-272 9679. Please quote reference No AB3(d).

Closing date: 10 September, 1987.

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HYDRAULIC FRACTURE RESEARCH

Engineering Project Leader

The BP Research Centre, based at Sunbury-on-Thames, is the Group's major R&D establishment and is one of the largest and most sophisticated centres in Europe.

We have a highly challenging opportunity to lead a multi-disciplinary team in the Exploration and Production Division. You will be leading the research in hydraulic fracture design, with the primary objective of improving well productivity through providing a sound engineering basis for the design, implementation and back analysis of hydraulic fracture stimulation processes. You will progressively assume increasing responsibility for the research programme in this important engineering activity and will develop a personal expertise providing consultancy services to BP's exploration operations. Allied geomechanical problems are also resolved by this project.

You should be at least in your late 20's and should hold a first degree in engineering (civil, mechanical, or engineering science) as well as a post graduate qualification in geotechnical engineering. You should also have industrial experience although not necessarily in the oil industry. Alternatively, candidates with different qualifications but with specific experience in hydraulic fracture stimulation research will also be considered.

We are seeking a candidate with enthusiasm who will be motivated by the application of research to substantial engineering operations in which the outcome is readily qualified.

Please write or telephone for an application form, **quoting ref: E84023,** to Anne Sheppard, BP Research Centre, Chertsey Road, Sunbury-on-Thames, Middlesex TW16 7LN.

BP is an equal opportunity employer.

BP Research SUNBURY-ON-THAMES

UNIVERSITY OF NOTTINGHAM

School of Agriculture

Forestry and Shelter for Animals

We are looking for a

RESEARCH ASSISTANT

with a keen interest in instrumentation and the application of physical concepts to the specification of the thermal environment of livestock. The assistant will study the microclimate and shelter afforded by different agroforestry systems. The project, to be funded for three years by AFRC, will be done in collaboration with the Macaulay Land Use Research Unit. Applicants, should have a good honours degree in Physics, Engineering or Environmental Science.

Salary from £8185 with possibility of higher degree registration. Starting date is October 1987. Applicants should submit their cv and the names of two academic referees by 18 September to Dr A. J. McArthur, Department of Physiology and Environmental Sciences, University of Nottingham, Sutton Bonington, Loughborough, Leics.

HAMMERSMITH AND QUEEN CHARLOTTE'S SPECIAL HEALTH AUTHORITY

Queen Charlotte's Maternity Hospital

Goldhawk Road,
London W6 0XG

SENIOR SCIENTIST MICROBIOLOGY/ VIROLOGY

Whitley scale A £11 833-£15 097 inc (under review).

We seek a science graduate with a first or second class Honours Degree, preferably in a biological science. Preference will be given to those with a higher University degree or diploma. You will be expected to undertake duties including research in Virology.

The hospital has a Day Nursery on the premises.

Further details are available from Mrs Paulette Mullings on 01-740 3923 and the laboratory may be visited by appointment.

Please send your cv and the names of three referees to Prof R. Hurley at Queen Charlotte's Maternity Hospital.

Closing date for receipt of application 4 September, 1987.

UNIVERSITY OF GLASGOW

Institute of Virology

Protein Engineering

Applications are invited for a new

RESEARCH ASSISTANTSHIP

in an existing research team. The post, funded by the SFRC Protein Engineering Initiative, is for one year (in the first instance) from 1 October, 1987 on Grade 1B of the salary scale for Research and Analoguous Staff (starting salary on range £8185-£9305).

The project concerns the functional analysis of the thymidylate synthetase of varicella zoster virus. It will involve protein purification and DNA sequencing. Some biochemical experience is desirable but not essential and applicants should have a degree in biochemistry, molecular biology or a related subject. For further details, Tel Dr R. Thompson at 041-339 8855, Ext 4630.

Applications should be sent to: Mr A. Whitelaw, Administrative Assistant, Institute of Virology, University of Glasgow, Church Street, Glasgow G11 5JR not later than 4 September, 1987.

CENTRAL MANCHESTER HEALTH AUTHORITY

Manchester Royal Infirmary

SENIOR PHYSICIST

(53/87)

Required in the Department of Medical Physics. The Appointee will join a team where the principal interest is in the development of Nuclear Medicine techniques, but he/she will also be responsible for work in "general medical physics". This will include scientific support for the use of non-ionising radiation, and the duties of laser protection adviser. Encouragement will be given to the pursuit of research interests.

In addition to extensive facilities for work with radionuclides, the Department includes well-equipped mechanical and electronics workshops, plus have strong links with both the Regional Department of Medical Physics and Bioengineering and the University of Manchester.

Applicants should have sound basic experience in any area of application of Medical Physics, and seeking to develop a career within the areas indicated. Minimum qualification is a good Honours degree, but preference will be given to those with a higher degree, and evidence of at least four years' constructive work in collaboration with clinical and scientific colleagues.

Informal enquiries/visits to Dr R. A. Shields, Chief Physicist, Tel: 061-276 4784.

Application forms/Job descriptions from: District Personnel Office, 2nd Floor, Cobbett House, Manchester Royal Infirmary, Oxford Road, Manchester M13 9WL. Tel 061-273 5642 (Ansafone). Closing date: 4 September, 1987.

MORE VACANCIES ON PAGES 2—10

Genetic Toxicologist

£9,700—£11,000 Cheshire

An opportunity now exists within ICI's Genetic and Experimental Toxicology Unit, Safety of Medicines Department, for a graduate, to join a team undertaking mutagenicity assays on ICI development medicines for regulatory purposes. The work will involve the operation of bacterial mutation assays, the modification of these assays and their validation using known mutagens/carcinogens for specific compound related problems.

Applicants must have a knowledge of microbiological techniques and at least two years' experience of regulatory bacterial mutation assays.
An understanding of genetics would be desirable.

We can offer excellent technical and recreational facilities situated in attractive Cheshire countryside about 15 miles south of Manchester.
Our salaries and related benefits are highly competitive and general assistance with relocation is available if appropriate.

Applications including a detailed CV should be addressed to:-

The Personnel Officer, (Ref GET2),
Imperial Chemical Industries PLC,
Pharmaceuticals Division, Mereside,
Alderley Park, Macclesfield,
Cheshire, SK10 4TG.

Closing date for applications is 11th September 1987.
This post is not suitable for new graduates or for those with a PhD.
Previous applicants need not re-apply.
ICI is an equal opportunities employer.

Opportunities for Graduates

Napp Pharmaceutical Group is one of Europe's most consistently successful pharmaceutical companies and our unique combination of technical innovation and sales and marketing expertise has firmly placed us in the top 25 pharmaceutical operations in the UK.

Napp Research Centre, the Research and Development part of the Group has excellent, superbly equipped laboratories with future plans for expansion. We are now looking for young, enthusiastic and highly numerate

Development Analysts

to join our Product Analytical Development team, which is responsible for the creation, design and refining of analytical procedures for the determination of drugs and ingredients in new formulations using HPLC, GLC, UV and IR spectroscopy.

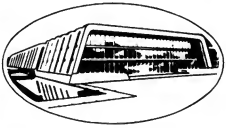
Our ideal applicants will be new graduates in Chemistry or a life science, who are strongly motivated to build a strong foundation for a career in the health care industry.

We also offer excellent salary and benefits which include annual bonus, pension scheme, free life assurance, 35-hour week, 23 days' holiday, subsidised staff restaurant and sports and social club.

Interested? Please call our Personnel Applications section on Cambridge 358888 Ext. 2000 for an application form.

NAPP RESEARCH CENTRE
The Science Park, Milton Road, Cambridge CB4 4GW.

NAPP *Member of Napp Pharmaceutical Group*



LEICESTER POLYTECHNIC
School of Life Sciences
David Attenborough Laboratories
SENIOR TECHNICIANS

Applications are invited for two posts of Senior Technician—Scale Six, to work in the new David Attenborough laboratories. Salaries £9966–£10 647 pa.

Senior Microbiology Technician—the appointee will take charge of a busy and expanding Microbiology Unit. The School has major interests in biotechnology and a knowledge of microbial genetics techniques and fermentation technology is desirable. applicants should hold at least an HNC/HND but preferably an Honours degree in Biological Sciences and should have experience of supervision and administration.

Senior Ecology Technician—the appointee will be responsible for the technical service in Ecology. The School has a major commitment to teaching and research in Ecology. Applicants should hold at least an HNC/HND but preferably an Honours degree in Biological Sciences and should have a knowledge of electronics/computing. A valid driving licence is essential and experience of Ecology field work will be expected.

Application form and further details available from Personnel Office, Leicester Polytechnic, PO Box 143, LE1 9BH. Tel (0533) 551551, Ext 2303.

Closing date: 3 September, 1987.

ST MARY'S HOSPITAL MEDICAL SCHOOL
(University of London)
Norfolk Place, London W2 1PG
RESEARCH ASSISTANT 1B
Paediatric Unit

Applications are invited for this post in which the appointee will be involved in work on monoclonal antibody techniques for antigen detection and quantitation; the work will also involve coagulation component and endotoxin measurements.

Practical experience in column chromatography is essential and experience in cell separation methods and cytology would be an advantage. The post is funded until December 1988 in the first instance. Salary in the range £8185–£11 015 pa plus London Weighting £1393 according to age, qualifications and experience.

The work will be under the direction of Dr R. P. A. Rivers.

Applications in the form of a full cv and the names and addresses of two referees to be sent to the Assistant Secretary (Personnel) at the above address by 4 September.

FIELD STUDIES COUNCIL
Juniper Hall Field Centre
Nr Dorking, Surrey RH5 6DA
Tel: (0306) 883849

DOMESTIC ASSISTANTS required as soon as possible for Household, Dining Room and Pantry duties. Long or short-term employment considered. Free board and lodging. Opportunities for own study/research using Lab/Library facilities. Apply Cook-Caterer.

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HAREFIELD HOSPITAL MIDDLESEX

We require a

HOMOGRAFT TECHNICIAN

for 20 hours per week, to join our exciting team. This post will involve travelling to Kingston and Chertsey Mortuary on a daily basis, to collect heart valves.

You will also be required to prepare the valves for use, store them and record the valves used and the sale to other hospitals.

Applicants with a Scientific or Nursing background would be ideal candidates.

Salary: £70-£90 per week, dependent on previous experience and qualifications.

Application forms available from: Personnel Department, Harefield Hospital, Harefield, Middx UB9 6JH. Tel: 089582 3737, Ext 624.

Closing date: 4 September, 1987.

STUDENTSHIPS

UNIVERSITY OF LONDON
The School of Pharmacy
RESEARCH STUDENTSHIP
in Antimicrobial Chemotherapy

Graduates with an honours degree in Biochemistry, Genetics, Microbiology, Molecular Biology or similar are invited to apply for a PhD Studentship to study the mechanisms of action of, and resistance to, antimicrobial agents that act on bacterial DNA synthesis.

Applications, including a cv, should be sent to Prof J. T. Smith, Microbiology Section, Department of Pharmaceutics, The School of Pharmacy, University of London, Brunswick Square, London WC1N 1AX.

UNIVERSITY OF CAMBRIDGE
Department of Physics
RESEARCH STUDENTSHIP

Applications are invited for a SERC research studentship to investigate the structure of amorphous solids primarily using neutron scattering techniques. The project will involve isotope substitution techniques and/or high pressure studies at the Rutherford Appleton Laboratory and the Institut Laue-Langevin, Grenoble.

Eligible applicants should contact Mr J. Deakin, Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE. Tel 0223-337421.

DEPARTMENT OF CHEMICAL ENGINEERING

Research Assistant Studentship

Removal of Heavy Metal from Process Streams

A collaborative project with BASF Chemicals Limited, UK (Seal Sands) funded through the SERC CASE scheme. BASF are one of Germany's largest chemical companies and the project includes liaison visits to Ludwigshafen.

The project will investigate the removal of cadmium metal from the company's process streams using electrolytic cells. Fundamental electrochemical studies of the deposition of cadmium from the aqueous based streams and plant feasibility studies are included in the research programme.

Applicants should have, or expect to obtain, a good Honours Degree or MSc. in Chemistry, Chemical Engineering, or a science related discipline. The post is tenable for three years and successful applicants will be registered for a PhD.

With departmental demonstration payment and the company contribution the successful applicant can expect to receive around £6,000 per annum tax free.

Applications should be sent to: Dr K Scott, Department of Chemical Engineering, Teesside Polytechnic, Borough Road, Middlesbrough, Cleveland, TS1 3BA or telephone 0642-218121 Extn. 42B1/4287 or the departmental office.

Teesside Polytechnic

Royal Holloway and Bedford New College
UNIVERSITY OF LONDON
EGHAM HILL·EGHAM·SURREY·TW20 0EX

Research Studentship in Physical Organic Chemistry

Applications are invited for a Research Studentship in Physical Organic Chemistry funded by MOD, to study the mechanisms of reactions relevant to the storage of hydrocarbon fuels, in collaboration with the Royal Aircraft Establishment.

The successful applicants, who should hold at least an upper second class honours degree in chemistry, will be registered for a PhD degree.

Please send, as soon as possible, a cv and the names and addresses of two academic referees to Dr R. A. Hancock, The Bourne Laboratory.

IMPERIAL COLLEGE
Department of Chemistry
RESEARCH STUDENTSHIP
LEADING TO A PhD

To collaborate with the Marine Biological Association and Lancaster University on a project aimed at developing a chemical model of actinide adsorption in the Esk estuary. The Imperial College contribution will be to characterise the surfaces of the particulate material and to study the relationships between the number of surface sites, surface area, pH, natural organic matter and actinide adsorption.

The terms of the studentship are similar to those for Research Council studentships, with a supplement of approximately £800 pa.

Applications to Prof L. V. C. Rees, Chemistry Department, Imperial College, London SW7 2AY. Informal enquiries, Tel 01-589 5111, Ext 4606.

UNIVERSITY OF SOUTHAMPTON
Clinical Pharmacology Group
RESEARCH STUDENTSHIP

Applications are invited for a three year research studentship leading to a PhD degree in the field of drug metabolism investigating the bioactivation of drugs by the body tissues and intestinal microflora.

Applicants for this post, which is available immediately, should hold a first or upper second class honours degree in Biochemistry, Pharmacology or related subjects. Applications in the form of a cv and the names, addresses and telephone numbers of two academic referees should be sent to Dr A. G. Renwick, Clinical Pharmacology Group, Bassett Crescent East, Southampton (Tel 0703-559122, Ext 4264) before 30 September, 1987. Please quote Ref 347/AJS/ma.

UNIVERSITY OF EDINBURGH
Department of Biochemistry

TWO RESEARCH STUDENTSHIPS IN PROTEIN CRYSTALLOGRAPHY

Applications are invited from suitably qualified graduates for two Research Studentships in this highly topical field.

(1) One studentship is sponsored by Sandoz AG in Basel, Switzerland, for work on a protein structure problem of particular pharmaceutical interest. The successful applicant will spend some time working in Switzerland under the supervision of Dr Malcolm Walkinshaw.

(2) The other one is an SERC CASE Studentship with the Hannah Research Institute, Ayr, and involves a study of the interaction of calcium with phosphoproteins, in particular the caseins from milk, under the industrial supervision of Dr Carl Holt.

Candidates, who should have an Honours degree (at least an upper second for the SERC studentship) in biochemistry, chemistry, physics or related subjects, will be under the supervision of Dr Lindsay Sawyer, from whom further particulars can be obtained and to whom applications, including a cv and the names and addresses of two referees, should be sent as soon as possible at the Department of Biochemistry, University of Edinburgh Medical School, Hugh Robson Building, George Square, Edinburgh EH8 9XD (Tel 031-667 1011).

Please quote reference 5484.

UNIVERSITY OF SURREY
Department of Physics

SERC CASE STUDENTSHIP

Applications are invited for an SERC CASE studentship tenable for three years, leading to a PhD degree. Applicants must have a first or upper second class honours degree in Physics or a closely related discipline.

The project, which is in collaboration with the Royal Signals and Radar Establishment, is concerned with the applications of modern parallel architectures to the processing of data produced by various imaging techniques. Techniques are to be developed that will allow best use to be made of the advanced features of such architectures for the reconstruction and further processing of diagnostic images.

Applications or enquiries from candidates with an interest in medical or other non-destructive diagnostic techniques, and with some experience of modern computer languages, should be addressed to:

Dr R. A. Bacon,
Department of Physics,
University of Surrey,
Guildford, Surrey GU2 5XH.
Tel (0483) 571281,
Ext 2713.

UNIVERSITY OF CAMBRIDGE
Department of Materials Science and Metallurgy
PHD STUDENTSHIP

Applications are invited from science graduates with good honours degrees for a studentship available on a project to investigate the effects of stress and environment on oxidation process instability using conventional methods and novel TEM approaches.

Write, together with cv and the names of two referees to: Dr W. M. Stobbs, Department of Materials Science and Metallurgy, Pembroke Street, Cambridge CB2 3QZ.

THE UNIVERSITY OF SHEFFIELD

Department of Zoology

Cephalopod Neurobiology

STUDENTSHIP

Graduates with a good honours degree in Biology, Physiology, Pharmacology or Zoology are invited to apply for an SERC studentship tenable for three years to work on the Neurobiology or Colour Change and/or the Motor System of octopusses and squids. Applications to Dr J. B. Messenger, Department of Zoology, The University of Sheffield, Sheffield S10 2TN (Tel 0742 768555, Ext 4630), as soon as possible.

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☐	28 - 30 Sept	Optical Measurement Techniques for Internal Flows
☐	19 - 23 Oct	Stressing & Vibration of Turbomachinery
☐	9 - 13 Nov	Compressor Design & Performance
☐	16 - 20 Nov	Microelectronics and its Use in R&D
☐	23 - 24 Nov	Boiler Efficiency Improvement
☐	23 - 27 Nov	Rotor Dynamics
☐	23 Nov - 11 Dec	Aircraft Gas Turbine Theory & Design
☐	26 - 27 Nov	Boiler Efficiency Improvement
☐	30 Nov - 2 Dec	Thermal Insulation
☐	7 - 11 Dec	Engineering Heat Transfer
☐	9 - 11 Dec	The Art of Communication for Engineers

To: Short Course Officer (Ref 1650), Cranfield Institute of Technology, Cranfield, Bedford MK43 0AL. Tel Bedford (0234) 750111, Ext 2776.

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Department of Applied Chemistry and Life Sciences

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(Ref No. R49/J)

in collaboration with Kenogard AB, Stockholm. Candidates must be qualified to register for MPhil/PhD of the CNAA.

Salary: £7275–£8058 (inclusive)

Applicants should send a cv quoting reference number, directly to The Personnel Office, The Polytechnic of North London, Holloway Road, London N7 8DB.

Further information is available from The departmental office. Tel 01 607 2789 Ext 2141.

Closing date for the receipt of applications: 4th September, 1987.

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AT CANTERBURY

BIOLOGICAL AND CHEMICAL LABORATORIES

Postdoctoral Fellowship

Applications are invited for a postdoctoral fellowship on an SERC grant to Dr S. J. Porter (Chemical Laboratory) and Professor C. J. Knowles (Biological Laboratory). The project is to investigate the scientific and commercial potential of novel polymers that conduct electricity to separate proteins and other charged molecules or living systems.

Applicants should be biochemists/microbiologists who also have a good background in chemistry or vice versa. The post is available for up to three years from 1 January, 1988, or as soon as possible thereafter. The starting salary is up to £10 440 on the Scale 1A.

Apply by letter with full cv, and the names and addresses of two academic referees, to Mr I. R. Stone, Senior Assistant Registrar, Faculty of Natural Sciences, The Registry, University of Kent, Canterbury, Kent CT2 7NZ, quoting reference A88/1. Closing date: 4 September, 1987.

John L van der Post Fellowship in Environmental Virology

DEPARTMENT OF BIOLOGICAL SCIENCES

UNIVERSITY OF WARWICK
COVENTRY CV4 7AL

Applications are invited for this postdoctoral fellowship funded by the Water Research Centre and to be held in the Department of Biological Sciences at the University of Warwick under the supervision of Dr. M.A. McCrae.

The aim of the fellowship is to investigate the application of rapid detection techniques, particularly those based on the use of recombinant DNA probes, to the detection of anteric disease viruses in polluted waters. The fellowship is available for three years on the Research IA scale: £9,305 to £14,825 p.a.

Application forms from the Executive Officer, Department of Biological Sciences, University of Warwick, Coventry CV4 7AL (0203 523517 direct line), quoting Ref. PDF/MAM/WRC/F.

Informal enquiries to Dr. M.A. McCrae on 0203-523524.

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UNIVERSITY OF BIRMINGHAM

Department of Physics

HIGH-Tc SUPERCONDUCTIVITY RESEARCH FELLOW
(Ref D4552)

Applications are invited for a three-year SERC-funded Research Fellowship to work in the University of Birmingham Consortium on High-Tc Superconductors, which is an interdisciplinary group working on the fabrication, characterisation, science and application of these recently discovered materials. Candidates will be expected to have a PhD in a relevant area of materials science or physics. Appointment will be on the Research Fellow 1A grade £9305–£14 825 plus superannuation.

For further particulars of the above post, Tel 021-472 1301, Ext 2559, quoting Ref No above. Three copies of application, including full cv and naming three referees to Assistant Registrar, Faculty of Science, PO Box 363, Birmingham B15 2TT by 4 September, 1987.

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UNIVERSITY OF ABERDEEN

Department of Pathology

Immunopathology Laboratory

POSTDOCTORAL FELLOWSHIP IN IMMUNOLOGY

An MRC-supported fellowship is available for two years from 1 October, 1987 or soon thereafter, for studies concerning the influence of cyclosporin in immunologically-mediated skin disorders. The work will involve both basic laboratory and clinical investigations. The successful applicant, who should preferably have a background and higher degree in immunology, will join a group with an established research record in cellular immunology and in evaluation of the properties of immunosuppressive agents. Starting salary £9305 pa, on the IA Scale for Research and Analogous Staff.

Further particulars and application forms from The Personnel Office, the University, Regent Walk, Aberdeen AB9 1FX (Tel 0224 480241, Ext 5351/4) to whom applications (two copies) should be returned by 11 September, 1987. (Ref WD/075). Informal enquiries may be made to Dr A. W. Thomson (0224 681818, Ext 52851).

UNIVERSITY OF EDINBURGH

Department of Chemistry

Postdoctoral Fellowship in Synthetic Organic Chemistry

Applications are invited for a Postdoctoral Research Fellowship funded by the SERC for research in collaboration with Dr Tom Brown and Dr George Tennant on the synthesis design of novel heterocycles for sequence-specific binding to nucleotides and probing drug-DNA interaction. Applicants should have research experience in general synthetic organic chemistry and ideally, though not essentially, a specific interest in heterocyclic chemistry. The appointment is for up to two years, the preferred starting date being 1 January, 1988, but later dates are negotiable. Starting salary will be at an appropriate point within the research range 1A (£9305-£11 015) depending on age, qualifications and experience. Superannuation Scheme.

Applications, including a cv and the names and addresses of two referees should be sent as soon as possible to: Dr George Tennant, Department of Chemistry, University of Edinburgh, West Mains Road, Edinburgh EH9 3JJ (Tel 031-667 1081, Ext 3423 or 3403) from whom further details may be obtained.

Please quote Reference number 5483.

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MARINE ECO-TOXICOLOGY

RESEARCH FELLOWSHIP

Applications are invited from Marine Biologists/Physiologists/Toxicologists to participate in an investigation of the effects of sewage sludge and its contamination on the egg, larval and juvenile development and on the reproductive capacity of selected marine fish.

The study is part of a cooperative project, for two years initially, between the Water Research Centre, Medmenham, DAFS Marine Laboratory, Aberdeen and Napier College, Edinburgh. Experimental work will be carried out at the Marine Laboratory Field Research Unit at Loch Ewe, Wester Ross.

Candidates should have a postgraduate degree in a relevant discipline and should preferably have experience in rearing and maintaining marine animals. It is essential that the successful candidate is prepared to work independently at an isolated Field Station. A driving licence is most desirable.

Application forms and further particulars available from: **The Personnel Officer, Napier College, 219 Colinton Road, Edinburgh EH14 1DJ. Tel (031) 444 2266 (Ext 4274 or 4288).**

Closing Date: 4 September, 1987.

BOOKS AND PUBLICATIONS

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ARIADNE

I suppose it is a little more trouble, but it cuts out cheating

IN JANUARY I noted that an alleged unidentified flying object had been sighted by the pilot of a Japan Air Lines cargo airliner over Alaska. More than this, reports said that the object, whatever it was, had been tracked on radar and had accompanied the Japanese aircraft for hundreds of miles. At the time, I hoped that we were going to hear more of this, as reports of UFOs are seldom followed up in the press, at least.

Lo and behold, the current issue of *The Skeptical Inquirer* carries an article by Philip Klass, who delved into the circumstances and information released by the Federal Aviation Administration in the US. This included tape recordings of radio communications between the pilot and controllers during the incident and details of what the radar actually showed at the time.

It showed "sporadically" a single blip near that from the airliner. Technical analysis revealed this to be a fairly well-known phenomenon caused by radar energy from a returning pulse arriving out of phase with that from the aircraft's radar transponder. The pilot, apparently, is a believer in extraterrestrial visitors and has a history of such sightings. On occasion he has agreed that pulsating lights indicating UFOs to him were caused by lights from small villages being diffused by thin clouds of ice crystals. Two other aircraft in the area at the time were asked to change course to have a look. They could not spot anything, though they could see the JAL aircraft. The crew in the cockpit with the pilot disagreed with the description of the lights he reported. Their own weather radar, showing a red display for strong echoes and green for the weakest, maintained a steady green while aimed directly at what the pilot was convinced was a giant spacecraft only a few miles ahead.

I trust that nobody argues that an airline pilot is necessarily better at observation and interpretation than other people. ☐

THERE ARE plenty of credulous people in the world and they include the French. News has reached me that a brewery in France is planning to launch an aphrodisiac beer. The first batch has been tried on staff at a brasserie in Strasbourg, with, according to the report, successful results.

It is hard to know which side is the more naive, those who drank the beer in the expectation of improved sexual prowess, or those who solemnly, or perhaps hilariously, accepted the stories of athleticism told to them afterwards by the drinkers. Strasbourg is, of course, known for its geese. ☐

WHEN it comes to celebrations, the British are not enthusiastic, on the whole, not even taking a holiday for Shakespeare's birthday or for St George on the same day. Perhaps it is something to do with the weather. For example, this year has, I imagine, daunted even that glum and stoical group, the English picnickers. Wet sandwiches are one thing, dissolved ones another. God knows what scenes have been viewed at Glyndebourne.

So I am not the least astonished to acknowledge that one of the decisive events in our history, the accession to the throne of William of Orange and the end of the Stewart monarchy normally passes unnoticed. But next year might be a little different. The William and Mary Tercentenary Trust is planning all kinds of splendours to mark the anniversary of James II's flight and William's landing, including a programme of events in which the Royal Society and the Royal Netherlands Academy of Science are collaborating. The Royal Society is offering W and M Fellowships and much will be made of Anglo-Dutch collaboration in science. ☐

ENGINEERING, the Design Council's magazine, has another publication concealed in it, called *Advanced Composites Engineering*. This has run, I see, an article on new knitting methods that can produce three-dimensional forms. Courtaulds, the article said, pioneered the development for making knitwear, but has gone on to use it for making glassfibre forms, for example. These can then be impregnated with resin to make rigid components. The system employs, as might be supposed, the familiar flatbed textile knitting machines, cunningly modified and under computer control.

This stirred a memory. In the early years of *New Scientist*, it, too, ran an article on the possibilities of knitting three dimensional forms, on machines under computer control. This article appeared in February of 1963 and it claimed that research on the idea had begun five years before that, the technique being based on that used for knitting the familiar Basque beret. Briefly, the procedure was to lay out any garment as it would appear if each section was opened up and stretched flat. A scanner looked at the result and simultaneously recorded the information needed for a machine to knit the shapes, on tape. The tape then became the instructions used to control the knitting process, during which the shapes were joined together to make the form of a jacket or whatever it was. The author, K. G. McQueen, of McQueen Cybernetics, said that the machine could knit any form and that it was promising for making those required for glassfibre structures.

That is as far as the echoes of the bell that rang have sounded, but it seems that the development of such systems has a fairly long history. ☐

ANIMAL skins like leather, pigskin, crocodile skin and so on are very hard to imitate: but it is wasteful and often ecologically harmful to get them by killing animals. Many snakes and lizards shed their skin at regular intervals anyway. A single animal could in principle supply a regular succession of skins without the need for cruelty or waste of resources.

So Daedalus is exploring the biochemistry of skin-shedding. According to one theory, it's a mode of excretion. The animal dumps harmful residues in the skin and later sloughs it off. So DREADCO's biochemists are feeding snakes and lizards on mildly biologically-incompatible materials, not toxic enough to kill an animal, but likely to be rejected into its skin. Cunningly, they are concentrating on plastics precursors and monomers. Some plastics are structurally rather akin to biopolymers; nylon recalls protein, for example, and the alkyd resins resemble natural fats. Such uneasily compatible compounds might well be rejected into an animal's skin. They would reinforce it into a still tougher and more durable product, and would trigger its shedding.

But what about those animals that don't shed their skin? In fact, says Daedalus, all animals shed their skin, even the leather-bearers and even man. In these creatures the skin grows continuously, being steadily renewed from below as the top layer dies; the dead outer layer continuously sheds its surface as microscopic flakes. DREADCO's reinforcing, polymerogenic diet will have a drastic effect on this sort of skin. The dead layer, strengthened by its plastic content, will no longer flake away but will remain as an ever-thickening integument. But when the diet is suddenly discontinued, skin-growth will revert to normal. The new skin will turn crumbly again, and the plastic-reinforced integument will lose its anchorage and be shed as a single splendid piece of leather! The animal will have to be freed from this detached but close-fitting garment.

Thus cows, horses and pigs could give leather throughout their lives, and leather goods would become cheap and universal. Even human-skin lampshades could be provided by volunteers, for the flourishing bad-taste market. ☐

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AIDS
THE FACTS
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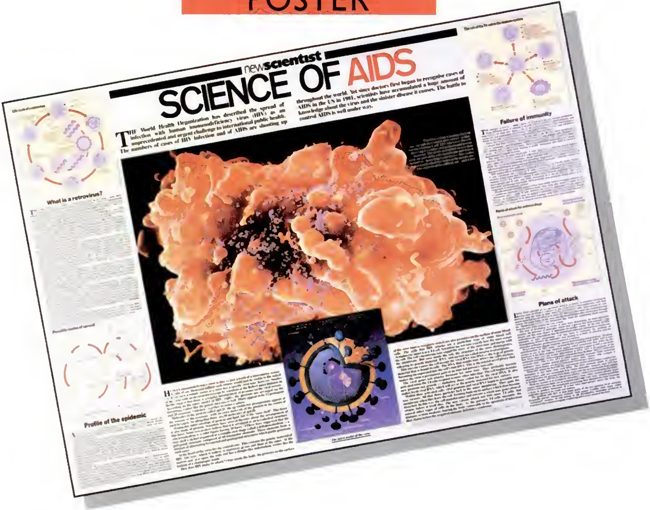

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